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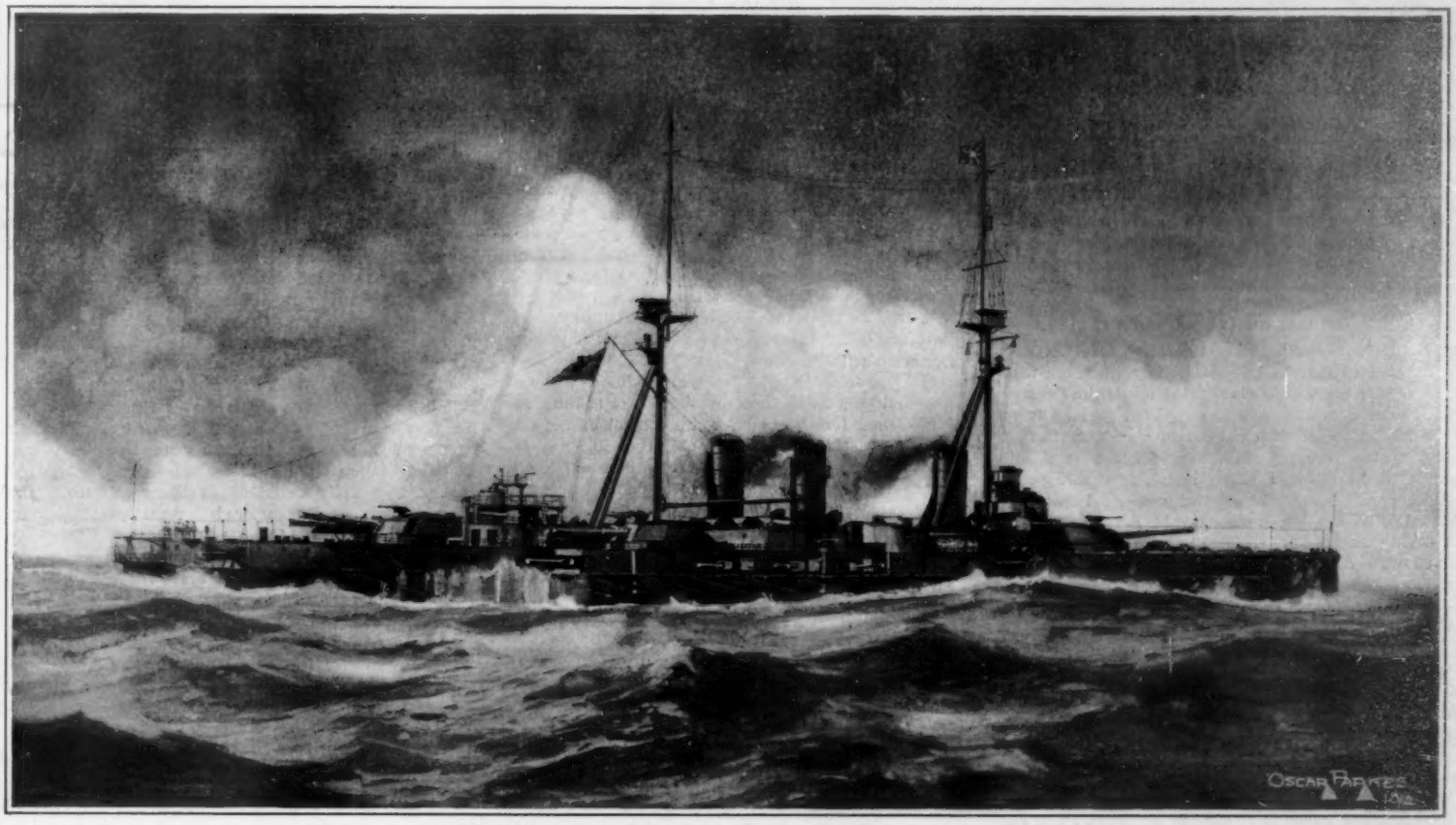
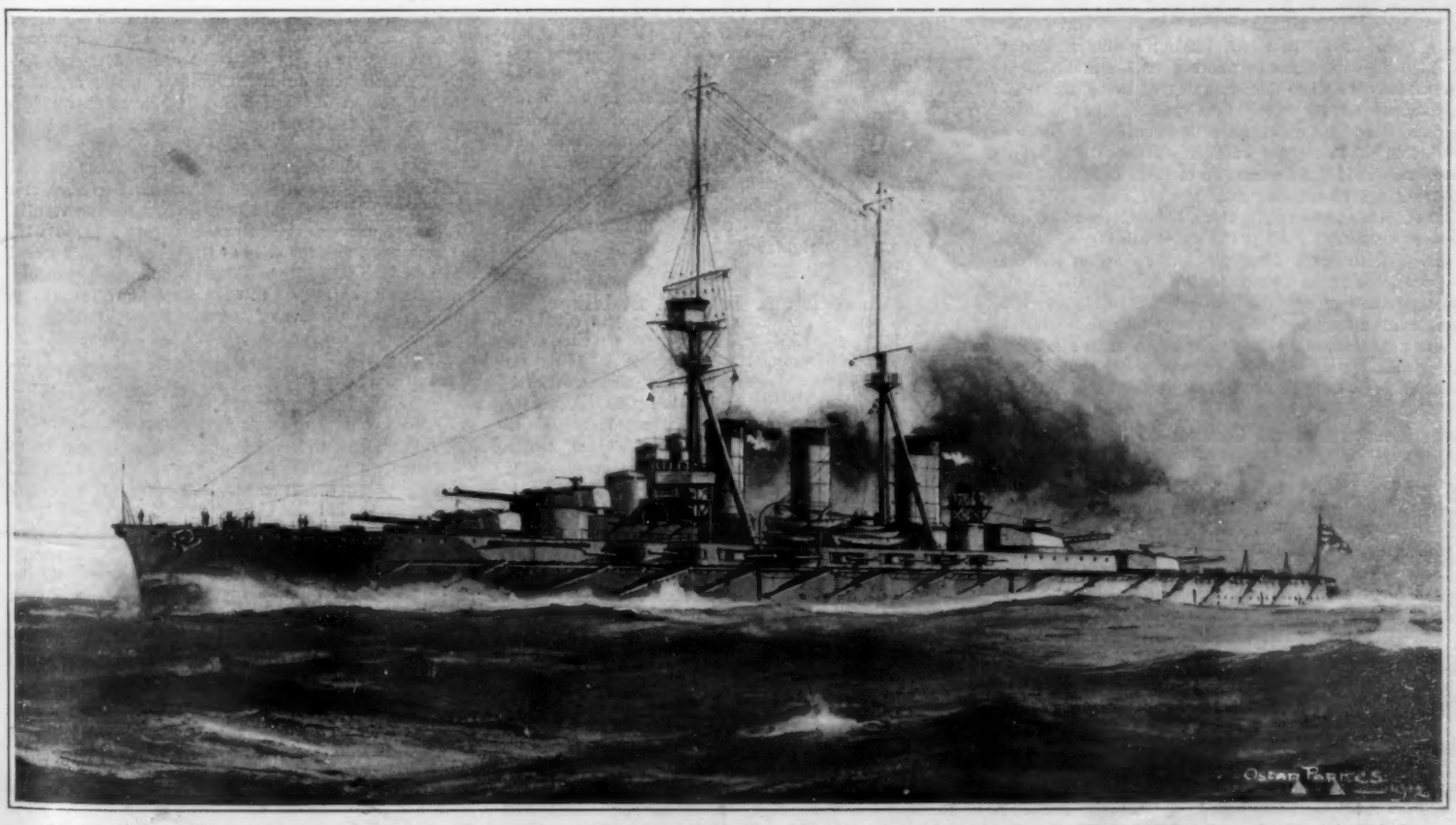


Length, 481 feet. **Beam,** 86 feet. **Draft,** 28¼ feet. **Displacement,** 20,750 tons. **Maximum Coal Supply,** 2,500 tons. **Armament:** twelve 12-inch; ten 6-inch; eight 4.7-inch. **Torpedo tubes,** five. **Armor:** belt, 9 to 12 inches. **Speed,** 20 knots.

New Japanese battleship "Kawachi."



Length, 704 feet. **Beam,** 92 feet. **Draft,** 27½ feet. **Displacement,** 27,500 tons. **Armament:** eight 14-inch guns; sixteen 6-inch guns. **Torpedo tubes,** five. **Armor:** belt, 10-inch; upper belt, 7-inch; secondary battery, 6-inch. **Speed,** 27 knots.

"Kongo," one of four powerful Japanese battle-cruisers now under construction.

NEW TYPES FOR THE JAPANESE NAVY.—[See page 138.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Col. Goethals on the Culebra Slides

IN the course of a recent interview, Col. Goethals assured us that he had no anxiety whatever with regard to the more serious problems on the Panama Canal. The dam at Gatun is completed practically to its full height, and with a head of over fifty feet of water against the upstream face for the past few months, it has proved to be both stable and proof against seepage, and the central core of impervious hydraulically deposited material is drying out and solidifying satisfactorily. The approach wall which had shown a disposition to settle has been straightened and is now secure against any further movement.

"But what about the unstable conditions at the Culebra Cut?" "We expect further slides there," said the Colonel, "some big slides, in fact, and they may occur before I get back to the Isthmus. But they are not giving me anxiety, nor will they cause any interruption to traffic after the Canal is opened. I have ordered two floating dredges of fifteen-yard bucket capacity, to be delivered in December, each of which can take out from 400,000 to 600,000 cubic yards of material per month."

The expected slides have already occurred. The old Cucaracha slide, which was supposed to be dead beyond resurrection, has come to life and sent down 400,000 cubic yards into the Canal, burying five of the tracks. Cucaracha is just to the south of Gold Hill; and a few days later 500,000 cubic yards of rock and clay broke away from Gold Hill itself, leaving a cliff which is expected to contribute to another half million cubic yards. Purple Hill to the south of Cucaracha, has been "weakened" on its north face, and another million yards may add its quota from this source. A mile or two north of this point another slide has developed, which may send down some two or three hundred thousand cubic yards into the cut.

All of which looks very serious, indeed, if we lose our sense of proportion; but if the slides are big, so is the capacity of the excavating plant. The steam shovels will keep the prism free until the cut is water-filled, and then the two new dredges referred to above, each capable of taking out some twenty tons of material at a single scoop, and removing between them a million cubic yards per month or more, will easily control the situation until Culebra shall finally cease to slide.

State Versus Federal Control of the National Forests

BECAUSE to be forwarned is to be forearmed, the SCIENTIFIC AMERICAN wishes with great emphasis to draw attention to the fact that a strong movement is on foot throughout certain sections of the country, and in Congress itself, to break down the system of national forest protection, by turning the national forests over to the States. Such a movement, if successful, would be a blow not only to forest protection, but to the whole movement for the conservation of the national resources of the United States.

One of the finest accomplishments of the Roosevelt administration was the legislation which was designed to protect the national resources of the country and secure their future preservation and wise and equitable development. This legislation met the national demand that the private exploitation of the forests, water powers and mineral lands of the country be abolished or at least controlled. It was realized that such control should be exercised, not by the various States in which the natural resources happened to be located, but directly and solely by the Federal Government.

Although the movement in favor of conservation was national in its scope and popularity; it aroused the bitter antagonism of those vested interests, which, under the old conditions were able to acquire and exploit the nation's resources to their own personal and enormous profit. The friends of conservation have realized from the very first that it was only a question of time when these interests would join in a concerted and active movement for the modification, if not for the repeal of the recently-enacted laws. At the present time, the agitation has taken the form of a struggle to remove the national forests from federal control and cede them to the States in which they are located. The movement, which has been growing in strength during the past few months, first assumed serious proportions about four years ago, when State versus Federal control of the natural resources was made a plank in many of the State platforms. That great activity is being displayed will be realized when it is stated that during the present Congress fourteen bills have been introduced, which are aimed more or less directly at transferring to the States the natural resources which are now under Federal control. The policy advocated in these bills has been openly and strongly supported by many members in Congress.

The sure way to defeat this conspiracy is to give it the widest publicity and inform the general public as to the true facts of the case. So far as the national forests are concerned, there are two principal reasons why they should not be turned over to the western States. One is that the step would involve a waste of money and effort, and the other is that the States are not furnished for the task. State control of the forests in the past, indeed, has not only been incompetent, but (and this is a much more serious matter), it has not been done with a single eye to the public interest.

The arguments against State control has a twofold aspect. In the first place, the national forests and indeed all national resources do not concern merely the interests of the one section of the country in which they lie. Rivers and forests, mineral veins and measures, the cattle ranges and the public land itself, do not stop at the State line. Certainly their administration in the interests of all the people of the country cannot stop at the State line. If their usefulness is to be developed to the fullest degree and for the benefit of the whole people and the whole country, they must be administered under national policies, decided from the national point of view.

The other argument for Federal control is based upon the undeniable fact that, if the natural resources were placed under State control, we should be subjected in an extreme degree to that political spoliation, which has already robbed the country of so much of its birthright.

Is it not a significant fact that the most bitter opposition to conservation comes from people who have an immediate or prospective interest in the personal acquisition of timber land, coal, water power, grazing, or any other of the natural resources belonging to the people at large? Why are these gentlemen such ardent advocates of State control? Why are they so reluctant to leave the control in the hands of the Federal authorities. Can they blame the country at large if it looks with suspicion upon arguments for State control, which it is asked to believe are based solely upon the abstract principle of State rights?

The Automatic and Inherent Stability of Aeroplanes.

WHILE automatic transverse stability is much to be desired in aeroplanes, fore-and-aft or longitudinal stability is of greater importance, as nearly all the fatal accidents due to faulty stability, occur as a result of diving, which would not happen, or at least would be corrected, if aeroplanes had sufficient longitudinal stability, or if they were provided with suitable devices to bring them automatically back to a level keel. Some attempts have been made to construct such devices, and one of them—the Doutre stabilizer—has been found to work fairly well; but of late more attention has been given to designing machines which will have inherent stability to a large degree, and thus will not depend upon automatic devices, which may sometimes fail, for the maintenance of equilibrium.

Early examples of the two methods of producing lateral balance are a V-shaped body and dihedral angle of the wings, typified in the Antoinette monoplane, and the use of a gyroscope as proposed by Maxim and others many years ago.

Recently Elmer A. Sperry has brought out a method of automatic operation of the elevator and ailerons by means of compressed air, the air valves being controlled by two tiny gyroscopes weighing 2¼ pounds each. Owing to the great sensitiveness of the gyroscope, the aeroplane can be kept on a practically even keel at all times, and also, according to Mr. Sperry, can be given automatically the proper banking on the curves.

Probably the first idea that comes to the average inventor who attempts to construct a system of automatic stability for aeroplanes, is that of the pendulum. A low center of gravity naturally tends to make an aeroplane stable, but the Wrights claimed that in connection with a dihedral angle it would produce rolling, which might become severe enough to capsize the machine. Consequently flexible wing tips and trailing edges were used instead by such men as Etrich, whose monoplane was described in SUPPLEMENT, No. 1933. These work very well, but later developments suggest that the center of gravity can be placed low without the serious consequences predicted. In the latest hydro-aeroplanes of the flying boat type, notably the huge machine built by Voisin for M. Deutsch de la Meurthe (which has carried seven men for about an hour), the center of gravity is very low since most of the weight is in the boat-like body below the planes, yet these machines have excellent stability.

The Moreau brothers, in France, early began experiments with a pendulum seat for the purpose of working the horizontal rudder and maintaining the fore-and-aft stability. Their experiments have met with success for some time past, and the French government has recently purchased one of their monoplanes such as we illustrate and describe on another page. The Wrights also have patented an automatic stability device depending on a pendulum, but it has not yet been put on any of their commercial biplanes. A number of the French military biplanes are equipped with Doutre stabilizers, which also maintain the fore-and-aft stability automatically. This device consists of a rectangular vertical plate which is moved back and forth by the varying air pressure, and which operates valves enabling compressed air to set the elevator properly. It has been fully described in these columns. The French constructor, Sommer, has recently brought out an improved device of this kind also.

Even better than the aeroplanes equipped with automatic stabilizers are those which are inherently stable, owing to their shape. Foremost among such machines are the biplanes and monoplanes of Lieut. Dunne of England, which have given some noteworthy performances such as flying without human control for a quarter of an hour or more. The Dunne machines are V-shaped in plan, the apex of the V being at the front and there being no rudders or tail. The wings slope downwardly to the rear in an inverse dihedral, and besides they have a constantly varying camber from the apex of the V to its ends.

The most recent machine having automatic stability is the Drzweicki following-surface monoplane, which was exhibited at the last Paris Salon. This machine is of the Langley type. Its chief point of interest is that the wings forming the following surface are set at a 3-degree less angle with the horizontal than are those of the front surface. The result is as great a lift from the rear plane as from the front one and the production of righting couples that counteract diving and keep the machine on an even keel. The machine was designed as the result of experiments made in the Eiffel aerodynamic laboratory. It has not been tested to any extent up to the present. Mr. Robert D. Andrews, in this country, conceived a glider along similar lines, and has tested it in small models with encouraging results. His rear surface is placed at a negative angle with the horizontal and the ends of the planes are connected together. The principle is different from the Drzweicki, but the result is similar in the production of automatic stability. An account of the Drzweicki machine appears on page 137, and full details of the experiments that led up to its construction are given in the current SUPPLEMENT.

A Bill to Increase Patent Fees

IT is difficult to understand why it is necessary to increase filing fees in patent applications from $15 to $20, as proposed by Mr. Bulkley in a bill recently introduced by him in the House of Representatives. Up to the present time about $7,000,000 has been earned by the United States Patent Office in fees, and turned into the Treasury of the United States. Obviously the Patent Office is not in need of money; it more than earns enough to pay for the cost of examining patent cases. If anything, inventors' fees should be reduced; for it is certainly not a function of Government to make money out of a class of men who enrich this country by hundreds of millions of dollars and many of whom begin their careers in anything but easy circumstances.

Record Altitude of a Sounding-balloon.—It is reported that a sounding-balloon sent up from the Observatory of Pavia, the headquarters of upper-air research in Italy, attained the unprecedented altitude of 23.4 miles. The previous record, 20.15 miles, was made at the Royal Observatory of Belgium, June 9th, 1911. The American record, 18.94 miles, was made at Huron, S. D., September 1st, 1910.

Electricity

Wireless to Germany.—The first wireless message sent direct from the United States to Germany was sent on January 17th from Sayville, Long Island, and received at the Nauen tower near Berlin, Germany. The distance is about 3,600 miles. Heretofore it has been necessary to relay wireless messages to Berlin and other points on the European continent.

Electrification of London Railways.—The London and Northwestern and the London and Southwestern railway companies are about to carry out an important electrification scheme involving over 150 miles of track in the metropolis. Direct current at 600 volts will be employed, with third and fourth rails, the trains being operated by the multiple-unit system. The scheme includes connection with the entire underground railway system of London.

Huge Electric Clock.—To advertise the Boston Edison Company, a large electric sign has been set up in that city measuring over all 54 feet in width by 60½ in height. The sign contains a clock with the dial 34 feet in diameter, at each side of which are columns studded with electric lamps. The minute hand of the clock is 18½ feet long and weighs 488 pounds while the hour hand is 14 feet 4 inches long, weighing 386 pounds. The total weight of the structure is 15 tons. Altogether there are 6,322 lamps used in the sign.

Curious Destruction of Fireproof Cables.—In a very serious fire which recently occurred in an English electric generating station certain cables, made with an outside covering of fireproof braid, were destroyed by fire in a remarkable way. The origin of the fire was a comparatively small blaze that had been started by an accidental short circuit. Although this first fire was promptly extinguished, it seems that the short circuit had enormously overloaded the first-mentioned cables, to the point of heating their stranded copper cores red hot. The expansion of the cores rent the fireproof braiding, exposing the rubber insulation underneath to the air so that it burst into flame.

Electrically-driven Ship Machinery.—A new English passenger and freight ship is fitted with electric motor-driven auxiliaries—one windlass, two winches, six cranes, and two warping capstans—supplied with current from a central electric generating plant. The machinery was especially designed for the rapid and quiet handling of cargo, and the electric drive gives a greater over-all efficiency than steam equipment, as the prime mover is a single large unit in which the steam is used very economically compared to the waste in the ordinary "donkey engine." Furthermore, the losses in steam pipes leading to each such engine from the boilers, by radiation and leakage, are eliminated, and the equipment does not have to be "warmed up," but is always ready to run.

Wireless Telegraphy Without Ground Connection.—The new wireless telegraph station at Fremantle, Australia, which has just opened communication with Sydney, across the 2,500 mile width of the continent of Australia, is operated without a ground connection in the ordinary sense. On account of the extreme dryness of the sandy soil at Fremantle (there is absolutely no rain during the six or seven summer months, and the underground water is at a great depth below the surface) a satisfactory ground connection could not be established readily. Accordingly an insulated counterpoise is employed instead, constituting the lower element of the electrically vibrating circuit of which the antenna is the upper element. The counterpoise consists of about a hundred insulated wires radiating out from the antenna tower and joined and supported by three concentric circles of wire. The web thus formed is supported on poles which are higher toward the center and lower at the outer edge, making a flattened cone-shaped network which gives an open shape to the vibratory circuit, insuring satisfactory radiation and a more outward reflection of the waves from the counterpoise.

British Electric Welding Practice.—A recent paper on electric welding declares that resistance methods, in which the heat is generated just at the spot where it is required, alone give true welding, every other process, electrical or other, involving the fusing of the two metals together. With an alternating current transformer the current required varies according to the size and nature of the work—from 50 amperes for a small wire welder up to 73,000 amperes on a large tire welder. Resistance welding is simple, accurate, reliable, speedy, and economical in quantity production. Chain links, for example, may be welded at the rate of 10 to 15 per minute. A tire welder can average 525 tires of different sizes per week, and spot welders can make 35,000 welds per week. The thermal efficiency of electric welding is as high as 75 per cent, and the mechanical efficiency attains 93.4 per cent, which compares favorably with hand welding. Iron and mild steel can be welded very satisfactorily, though high-carbon steel (0.8 per cent carbon) does not give as good results. Copper and its alloys, nickel, aluminium, silver, gold, platinum, iridium, and brass do not lend themselves to spot welding and must be butt-welded.

Science

The Unusual Turbidity of the Atmosphere, which began last June and appears to have continued through the summer and autumn, is to be made the subject of an investigation by the U. S. Weather Bureau. A circular requesting notes of any observations that have been made of this phenomenon has been addressed by the bureau to a number of astronomers and meteorologists.

A Prize of 2,000 Marks has been awarded by the German Meteorological Society to Mr. Ernest Gold, of the British Meteorological Office, for the best discussion of the results of the international investigations of the upper air. Mr. Gold, who is only 31 years old, is probably the highest English authority on dynamic meteorology, and is one of the brilliant group of Cambridge men who have given the British meteorological service its present conspicuous position in the scientific world.

The Source of the Kongo.—A telegram from Sakania, Belgian Kongo, announces that the German officer, Lieut. Grätz, who in 1909 crossed Africa in a motor-car, has now accomplished the same feat by motor-boat. The most important geographical result of the enterprise appears to be the discovery that there is a continuous waterway from the source of the Chambezi, in northern Rhodesia, to the River Kongo, which is thus proved to be the longest river in Africa.

Sodium and the Series of Radio-active Elements.—In a recent number of *Science*, Prof. F. C. Brown discusses the evidence that sodium belongs to a radio-active series of elements. "Geophysics," he assures us, 'furnishes two distinct lines of evidence which favor the hypothesis that sodium belongs to a series of radio-active elements. The first is based on the age of the earth as determined by radio-active data and by the accumulation of sodium in the ocean. The second is based on the relative accumulation in the ocean of sodium compared to chlorine, taken in connection with the relative annual output of these two elements by the rivers."

New Radio-telegraphic Stations in the Arctic.—In view of the attempts now under way to accomplish the Northeast Passage, and the much-discussed question of establishing regular trade-routes by water to the Arctic coast of Siberia, great interest will be felt in both scientific and commercial circles in the announcement that the Russian government is installing radio-telegraphic stations at the entrances to the Sea of Kara; viz., at Vaigach Island, Yugor Strait, and Morosola. Hereafter vessels bound for that sea will be able to lie in safe harbor at Vardo or Archangel until they are advised by wireless that the passages are free from ice.

The Plants, Animals and Birds of the Bible have been made the subject of a special exhibition in the Natural History Department of the British Museum, South Kensington, and the trustees of the museum have published an interesting "Guide" to the collection. Among the striking bits of information contained in this work are the following: The common fowl is not mentioned in the Old Testament, and was probably introduced into Palestine after the Roman conquest. The "unicorn" of the Old Testament was probably the Syrian aurochs, now extinct. That the "behemoth" was not the hippopotamus is made probable by the fact that there is no record of the latter animal in Syria or Palestine in historical times. The "tares" of the Bible were darnel grasses, whose seeds are poisonous; the "rose" was probably the narcissus; while the "lily" was the poppy anemone.

The Recent Progress of Actinometry is discussed by Dr. J. Maurer, president of the International Commission on Solar Radiation, in the recently published report of the last meeting of that organization, held at Vienna in September, 1912. For years measurements of solar radiation were made in various parts of the world with a number of mutually incomparable instruments, including some of very little scientific value; e. g., the black-bulb thermometer. The International Meteorological Conference held at Innsbrück, 1905, recommended the universal use of the Angström pyrheliometer, and this instrument has since been employed at most large meteorological observatories, as well as in the course of special investigations, as for instance on various mountains (Monte Rosa, Sonnblick, etc.). Thus science now finds itself in possession of a fairly large body of data on the intensity of solar radiation in different parts of the world, obtained by identical and approximately accurate methods; a class of information the need of which has been sorely felt in meteorology. Unfortunately, however, doubts have recently been cast upon the complete reliability of the Angström instrument, especially by Kimball, in America, who finds that this instrument gradually deteriorates in accuracy. A more favorable view is taken by Marten, of the Potsdam Observatory, and among others opinion seems to be divided as to whether the Angström pyrheliometer should be retained as the standard. The silver-disk pyrheliometer of Abbot is coming into wide use. Thus the initial problem in the much-needed world-wide study of solar radiation—the selection of a satisfactory instrument—appears to be still unsolved.

Aeronautics

The Automobile Lamp and the Radiator Casing.—In patent No. 1,048,530 Don W. Harlow of Cleveland, Ohio, presents an automobile radiator casing which is expanded at its opposite sides in its upper portion beyond the normal outlines of the radiator and sleeves are provided within the expanded portions to receive the lamps so that the lamps are inclosed within the radiator casing.

Another Flying-machine Patent.—In patent No. 1,049,315 Eli Pollak of Washington, D. C., assignor of one half to Edward E. Clement of Washington, D. C., shows a flying machine comprising two longitudinal cylindrical bodies which are connected at their ends to form an elongated integral rigid gas bag or envelope which has a greater width than depth and a longitudinal open space in which a car is hung, the gas bag forming an aeroplane.

Flights in Greece.—Favored by fine weather, Labouret made a number of over-sea flights near Athens, and after flying in the neighborhood of Salamis he then came above the Acropolis and the Parthenon at a great height. His performances at the Piræus port were witnessed by great crowds of spectators and also by the ministers of war and the navy. In all these flights he carried two passengers on board, these being the pilots Guinard and Berni. The latter is proceeding to join the Epirus army with an aeroplane which he is to pilot. The Greek lieutenants, Notaras and Kamberos, are embarking with their Farman biplanes in order to join the same army. Lieut. Kamberos lately made some remarkable flights above the islands of the Ægean Sea upon a Farman hydro-aeroplane.

An Incendiary Bullet.—Tests have been made in Germany with a special projectile which is intended to repel dirigibles and which is designed not only to pierce a gas envelope but also to set fire to the gas. This projectile, fired from the old German rifle known as "model 71," which has a caliber of 11 millimeters, is provided with little wings that open in flight under the influence of a spring, compressed while the projectile is still in the rifle barrel but expanded as soon as the muzzle is passed. An ordinary bullet leaves such a small hole in an envelope that the gas escapes through it but slowly. The wings on the improved bullet tear a hole of appreciable size in the fabric. What is more, they retard the bullet sufficiently to cause a friction device to ignite fulminate contained in the bullet. It is said that experiments conducted at Neumannswald gave encouraging results.

Another Proposed Transatlantic Flight.—The aviator Beckmann, of Cologne, is preparing to make a sensational flight across the Atlantic next spring from Europe to America. He intends to start from the Da Rocha Cape in west Spain and fly across to Fercheira, the first of the Azores Islands, or 1,000 miles. From there he is to attempt the flight across the ocean to Halifax, which will mean about 1,800 miles. He will take on board 2,000 pounds of gasoline and oil, and is to fly for about 11 hours at 90 miles an hour for the Azores trip. Then he will take on 4,000 pounds of gasoline, and the flight to Halifax will last 22 hours at a somewhat slower speed. This German transatlantic machine is to be a monoplane of no less than 33 feet in length and 56 feet spread, having a supporting surface of 540 square feet. The weight of the aeroplane is 1,500 pounds, and the framing is of steel tubes. It is to have two revolving-cylinder motors each driving one propeller. Wireless apparatus and searchlights will be carried on board. This may be another case where wireless will prove useful at sea.

News of Buc.—The Buc grounds near Versailles are likely to become the leading aviation center in France. Among the constructors, Esnault-Pelterie, M. Farman, H. Farman and Borel have already installed headquarters on the grounds, and at present Blériot is establishing a model aerodrome of considerable size. The work is, in fact, nearly finished, and the new quarters, built entirely of brick, comprise a main building used as an immense hangar, with two wings of two stories each. The great hall of 170 feet in length is able to house quite a number of aeroplanes, and counting the repair shops which lie at each end, the building is in reality over 300 feet long. In the wings there are installed on the ground floor the offices and a store room with extra parts for aeroplanes, besides a good-sized workshop. On the second floor are the apartments used by the pupils, workmen, guards, etc. Blériot also has dwelling quarters here so as to be able to work when need be. Adjoining the main building are two metallic hangars which already contain several aeroplanes. It is expected to have about 25 aeroplanes in use for instruction of pilots, at the start. Behind the hangars will be built the automobile sheds, and upon the main road is to be erected a monumental entry for the Blériot aerodrome which will cost $35,000 alone. The track of the aerodrome is already traced, and it will be of unusual size. It runs around the Buc fort and incloses no less than 500 acres. M. Collin, who has already trained 250 pilots in the Pau and Etampes Blériot schools, is to have charge of the aerodrome.

The Voice-operated Typewriter

ANALYZE the physical operation of taking down dictation on the typewriter. The dictator pronounces a word, say "met," and within a fraction of a second, the letters "m-e-t" are struck upon the machine.

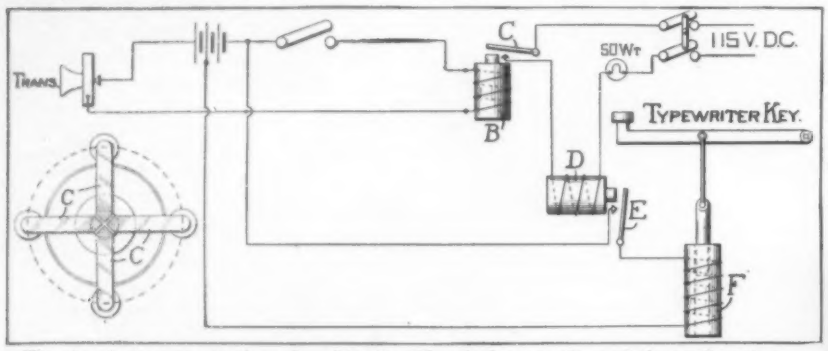


Fig. 1.—Arrangement of reeds. Fig. 2.—Electrical connections of the reed system.

In that brief interval of time the following operation takes place:

The ear drum of the typist is set vibrating as it receives the sound waves from the dictator. Superposed upon the main sound waves are overtones of different frequency, one characteristic overtone for each letter of the word. These waves are communicated to a set of fibers in the cochlea or internal ear. There are many thousands of these fibers, each tuned to vibrate to its own individual frequency. Three of these fibers are then vibrated more strongly than the rest, one after the other, to correspond with the "m-e-t" sounds, and the excitation of these fibers is communicated to the brain, which in turn controls the muscles of the typist's fingers, causing them to strike the corresponding keys on the typewriter. No complicated mental processes need be involved in the operation. It is quite mechanical. Indeed, the typist may have been and probably was thinking of something quite foreign to the subject. But if the system is mechanical, why does not some one build a mechanical substitute for the typist, so that the dictator may control the machine by voice, without a human intermediary?

Mr. John B. Flowers, a young electrical engineer of Brooklyn, has actually made the attempt, and with a considerable measure of success. In his apparatus a telephone diaphragm takes the place of the human ear drum; instead of the fibers, he employs a set of steel reeds, respectively tuned to the different overtone frequencies of the alphabet; for nerves he uses electric currents, and for the human hand a bank of solenoids.

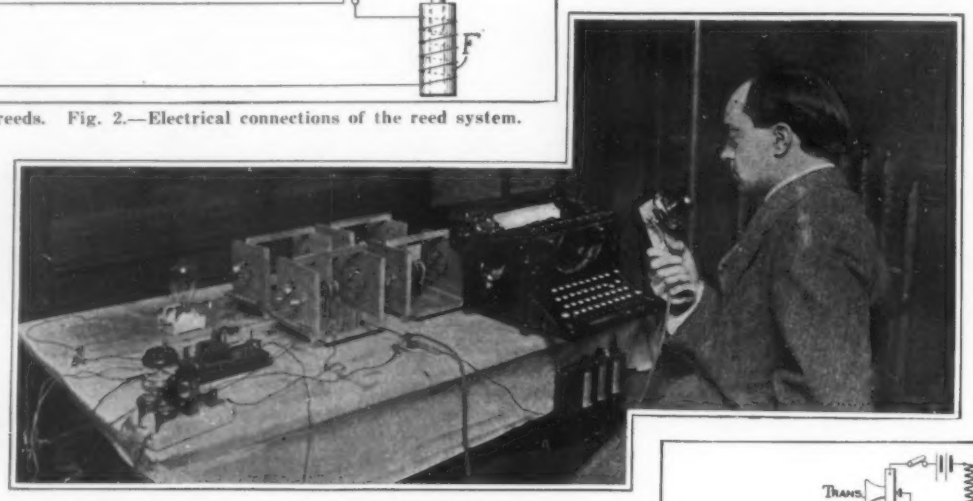
A diagram of the arrangement is shown in Fig. 2. When a word is spoken into the transmitter, the field of the electro-magnet *B* is varied in accordance with the sound waves impressed on the diaphragm of the transmitter. There are four electro-magnets *B*, and each is fitted with eight reeds; but for purposes of illustration and for the sake of simplicity, we have shown only one of the magnets and a single reed *C*. Although the reeds are tuned to different wave frequencies, they are all vibrated more or less by the variations in the field of the electro-magnet. But as each letter sound is uttered, the reed that is tuned to that particular letter vibrates more strongly than the rest, and closes the circuit of the corresponding relay magnet *D*. This closes the switch *E*, actuating the solenoid *F* to pull down the key of the typewriter.

The electro-magnets *B* are virtually telephone receivers and the reeds *C* are their diaphragms. Fig. 1 shows how the reeds are mounted at each end of the magnet *D*. It is as if the diaphragm of the receiver had sectors cut out of it, leaving a cruciform diaphragm mounted on standards at the four extremities and separated into four reeds by cutting it apart at the center. It is evident that these reeds would vibrate more or less according to the sound, just as a telephone receiver diaphragm would.

With this crude apparatus, which is shown in the accompanying photograph, the inventor has succeeded in recording on the typewriter all the vowels and the consonant "P." The consonant sounds are much more difficult to reproduce for the reason that they are of shorter duration, and any mechanical device such as a reed would be too sluggish to respond to them. However, the inventor expects to overcome this defect by using electrical resonators in place of reeds. The arrangement is shown in Fig. 3. In this case the transmitter circuit connects inductively with the resonator mains *H* and *I*, across which are connected resonant local circuits each comprising a balanced inductance *K* and capacity *J*. On speaking the word "met" into the transmitter, the three local resonant circuits corresponding to the letters "m-e-t" are successively thrown into resonance, the current rising to a high value. A small vane of some magnetic material is caused to be pulled into the center of the coil *K* of those circuits which are highly excited, thus closing the circuits of the solenoids *F*, working the keys of the typewriter. The electric resonator system has not as yet been put to a practical test, but theoretically it should be very sensitive and quite capable of catching the overtone characteristics of the consonants.

Apparently, then, all that the dictator need do is to speak into the ear of this mechanical typist and his

(Concluded on page 146.)



A machine that typewrites what is spoken to it.

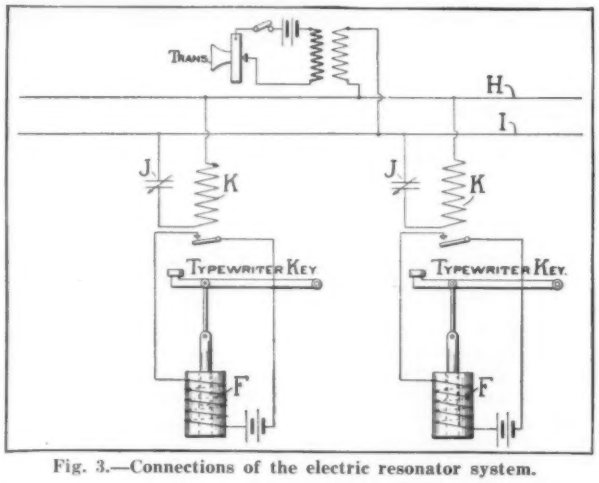


Fig. 3.—Connections of the electric resonator system.

Architecture on the Panama Canal—A Suggestion

NO one who is familiar with our columns would question the friendly spirit in which the criticisms suggested by the two adjoining sketches at the bottom of this page is made. The character of the permanent masonry work along the Panama Canal is such that it does not admit of much architectural adornment or expression; and in view of the magnitude of the huge monolithic masses which constitute the locks, spillways, etc., we think it will be agreed that the simplicity which characterizes these works is appropriate. At the same time, in the designing of the subordinate or accessory structures, such as power houses, range towers or lighthouses for marking the course of the vessels, and the permanent buildings for housing the operating and military forces, we think that great care should be taken to render them architecturally harmonious with the spirit and purpose of this, the greatest engineering work of the day.

The range towers, of which there is a large number placed at intervals along the sailing route of the canal, are concrete structures of circular cross-section and of simple and appropriate design. In the case of one of these towers, known as front tower of range Nos. 1-2 in the Gatun Lake section, it became necessary to make a radical change of form, owing to the peculiar requirements of the site, and the result is shown in the accompanying halftone engraving which is reproduced from the last annual report of the Panama Canal Commission. The tower is situated on the south middle wall of the Gatun locks, which extends from the main structure several hundred feet out into the lake. Upon this wall are located three tracks for electric towing locomotives, one on each edge of the wall, used when the ships are in tow, and a third track to enable the locomotives to return after they have carried a ship through. In designing this range tower, it became necessary to depart from the standard circular form, since the structure had to span the central track with sufficient clearance to allow of the passing of the locomotives.

Unfortunately, the problem was treated as one merely of engineering. Four concrete pillars 20 inches by 24 inches in section were carried up the desired height, arches were thrown in, and a platform was formed above them. From the center of this relatively slight rectangular base rises the massive circular shaft of the lighthouse.

Now, although, from the engineering standpoint, this is a perfectly satisfactory structure, we must confess

(Concluded on page 146.)

Gatun locks range tower as built.

The tower as it might have been built.

The Moreau Automatically Balanced Monoplane

M. MOREAU of Paris has been testing a monoplane which commands attention chiefly because it is provided with an automatic stabilizer. He claims that he has flown thirty-five minutes without touching a lever, steering with his feet. By what the writer saw in a short flight, he believes that the feat is possible in good weather.

It has provision both for automatic stability and for personal control. The lateral automatic stability is secured partly by the wing shape, partly by the low placement of the mass center. These are old and obvious devices which serve in favorable weather and in easy maneuvers. Longitudinal automatic stability is secured by placing the pilot in a pendulum seat shielded from the wind, movable only in a fore-and-aft direction, and actuating control cords running back to the horizontal rudder. This general pendulum device for automatic control has formed the basis of many patents, but as here applied has some noteworthy features presently to be indicated.

As to the mechanism for personal control, the steering is done by the feet working cords connected with a rear vertical rudder; the lateral poise is effected by ailerons operable by a special lever; the longitudinal poise is obtained by another special lever operating the horizontal rudder. All these personal control devices are old and well known.

The most interesting feature of the Moreau monoplane is the combination of arrangements for longitudinal control. As already stated, the rear horizontal rudder is operable automatically by the pilot's seat, movable only lengthwise of the machine, and manually by a special hand lever. But, furthermore, there is a brake operable either by the hand actuating a lever or by the wind acting on a pressure plate, whose function is to lock the pendulum seat so that the whole machine becomes, for the time of braking, as one rigid body. Thus the aeroplane is instantly convertible from one having either manual or automatic control to one having only manual control, and in either case it has considerable inherent stability by virtue of its shape and low center of mass.

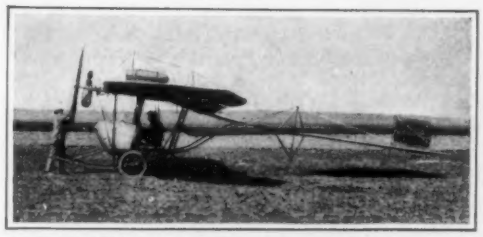
The pilot-seat pendulum of Moreau's monoplane, which has also characterized the designs of other inventors, has the advantage of exerting sufficient force to work the control wires unaided by auxiliary power; whereas the light pendulum controls so frequently proposed, during the past generation or more, for automatic stabilizing, require some intermediate mechanism and a special source of power, such as compressed air, or gearing driven by the motor, etc. But it may be observed also that the period of vibration of the larger pendulum is longer than need be for a small one, and hence in some circumstances its action may not be quite so prompt. The ideal aeroplane pendulum would always maintain a fixed direction, or, if disturbed, would promptly and without oscillation resume its normal direction, say the vertical. Like the magnetic needle, it would be unaffected by sudden shifting or acceleration of its pivot. The aeroplane could then be given a definite poise with respect the normal position of its pendulum, with the assurance that the poise would in general be uniform. But the ordinary pendulum, when its pivot is accelerated transversely to the line of suspension, promptly deviates from the natural plumb, to which it tends to return for repose gradually after one or more vibrations. The more frequent and prolonged these oscillations, the more unsteady the control of the machine on its course.

If, for example, the aeroplane is accelerated on its path, as when starting along the earth, or when the propeller thrust suddenly increases, the pendulum tends to lag behind, thereby changing the angle of the rudder more, perhaps, than the circumstances require, if any change at all be desirable at the instant. Conversely in landing, when the propeller thrust suddenly diminishes, the pendulum swings ahead of its natural plumb position with a consequent disturbing effect on the evenness of the straight forward flight. But if a brake be available, which automatically locks the pendulum during certain extraordinary accelerations of the aeroplane, due to sudden changes of propeller thrust or sudden wind gusts, these violent movements of the pendulum and their consequent disturbing effects are obviated.

Apparently such a pendulum control should be regarded as a fair weather device. In long voyages it can relieve the pilot during much of the time, even if it cannot be depended upon to save him in the most severe atmospheric conditions. It may be expected, therefore, that if nothing better be forthcoming, the pendulum control will win favor with some aviators, as a convenient auxiliary, if not as a life preserver. But it must be remarked that, although practical automatic controls of various pendulum types, as well as other kinds, have been shown by their inventors to be mechanically operative, they have not made remarkable headway toward general adoption, either by operators or by manufacturers of aeroplanes. These remarks apply to pendulums of ordinary type, whether working the controls directly by their own weight, or through intermediary gear involving electric clutches, compressed air cylinders, or the power of the aeroplane motor.

In closing, reference may be made to an automatic stabilizer governed by an extraordinary pendulum. Mr. John Tarbox of Washington has pivoted a bar pendulum at its center of gravity so as to obviate disturbance due to sudden shifting or acceleration of its axis. In order to endow it with a tendency to stand plumb, one end is made bulbous, and the whole is immersed in a liquid contained in a box mounted on the aeroplane. The pendulum is used to operate a clutch, whereby the power of the motor may be engaged to work the control wires of the aeroplane. The Tarbox stabilizer, when mounted on a biplane of the Curtiss type, enabled it to maintain a level poise in cross-country flying, and to fly continuously round a curved course, steadily maintaining a given bank in calm air, and promptly returning to its prescribed poise when navigating disturbed air. As witnessed by the writer, in 1911, it was used to control only the ailerons, but it can as well be applied to control the horizontal rudder. The inventor claims for this stabilizer all the merits of those operated by common pendulums, plus the additional advantage that his pendulum is unaffected in verticality by any acceleration of the aeroplane due to sudden change in the propeller thrust, etc., as observed for the Moreau machine. The correctness of the principle of the Tarbox pendulum may be left to the intuition of the reader, or as an exercise for his skill in hydromechanics. The question is: Whether a pendulum pivoted at its centroid and more buoyant in its upper than in its lower part, will preserve its verticality while its axis is being transversely accelerated?

Three-quarter front view, showing aviator and passenger.

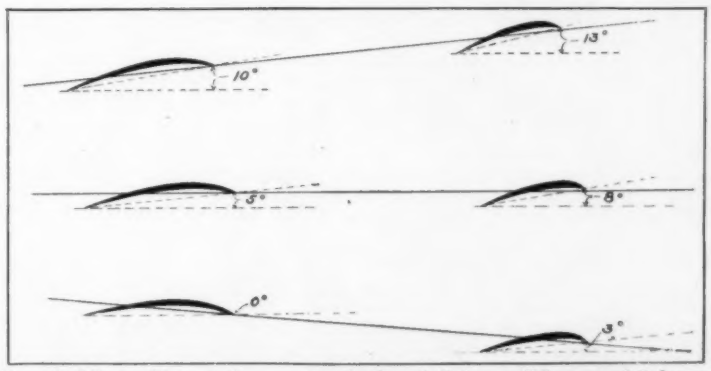


Side view of Moreau monoplane.

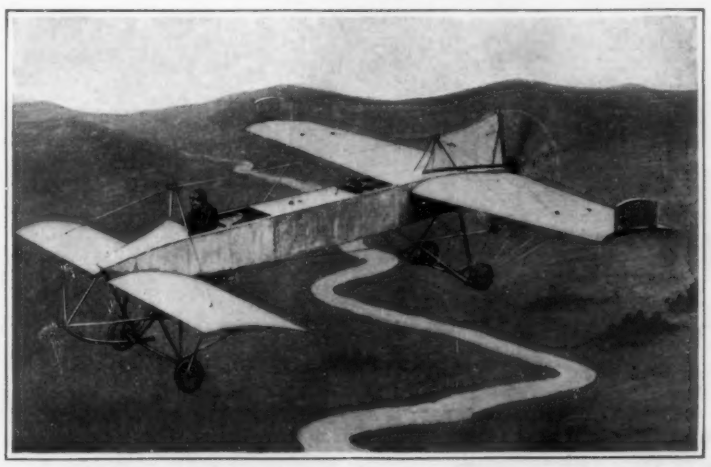
Near view of the pendulum seat.

The Drzewiecki Following Surface Aeroplane With Inherent Longitudinal Stability

THIS machine is distinctly of the Langley type, and it is the outcome of the various foreign machines of the Canard type originated by the Voisins several years ago, and first tried by Santos Dumont in his original aeroplane—the first heavier-than-air machine to fly in France. The Canard type consists of a long body carrying the elevator and vertical rudder at the front end and the supporting surfaces at the rear end. The aviator was placed just in front of the planes in the body, and the motor was placed at the rear part of the lower plane as in the usual biplane. The Drzewiecki machine, however, has both surfaces of the same size and both lift about the same amount. Both the men and the motor are placed in the body between the two supporting surfaces, while the propeller is located at the rear end of the body, behind the second plane. The center of gravity is practically at the center of the fuselage, half way between the two surfaces. This is important, as the position of the center of gravity influences the direction of the correcting couple when the machine tends to lose its balance, and also affects the magnitude of this couple. The machine is balanced in such a way that in ordinary flight the front surface has an angle of 8 degrees, and the rear an angle of 5 degrees. There is, therefore, a dihedral angle of 3 degrees between the two surfaces in a longitudinal direction. The front plane has the profile curve of the No. 8 Eiffel surface which gives, at 8 degrees, a lift of $K'y = 0.058$ practically, while the rear plane has the profile curve of the No. 13 *bis* Eiffel surface (Blériot No. 11 *bis*), which gives at 5 degrees a lift of $Ky = 0.041$ approximately. Moreover, because of the difference in the two planes, the total lift of the front one varies less quickly than that of the rear when the angle of incidence changes. If, therefore, the machine gets out of equilibrium, or in other words if the two lifts of the front and rear planes no longer balance each other with respect to the center of gravity, and the machine tends to rear, the lift of the second surface increases more quickly than that of the front one, and a couple is developed that tends to raise the rear of the machine and correct the increase in the angles of incidence of the two surfaces (see diagram). In the case of a dive, where the angles of incidence of the two surfaces



Drzewiecki's machine rearing, on even keel, and diving, a difference of 5 degrees between each position.



The Drzewiecki tandem monoplane constructed according to results of Eiffel's aerodynamic research.

diminish, the difference in lift of the two planes occurs in an opposite manner, and the greater lift of the front one brings the machine up to an even keel once more.

This principle was tried out in the Eiffel laboratory on a model one tenth the size of a full-sized machine. The model was suspended at different angles of incidence and the experiments proved that it is possible to obtain longitudinal automatic stability by the arrangement of the planes shown in the diagram, whereby the rear plane is set at an angle of 3 degrees less than the front one. Moreover, it has been proved by experiment that when the planes both have the same angle, the lift of the second one is practically nothing. If the second plane is given 5 degrees less angle than the front one, there is no lift at all, but rather a downward force. If the second plane has less angle at 2½ degrees than the front one, however, the lift produced is practically the same as that of the front one, so that in addition to obtaining automatic stability, a lift as great or greater than that obtained with an ordinary biplane is to be had. These results were obtained experimentally by Eiffel, and M. Drzewiecki constructed his machine in accordance with them. The forward wings can be turned about their axes in order to correct the lateral balance, and also to increase or decrease their angle of incidence when it is desired to rise or descend. Each wing is built about a central spar that turns in a ball bearing, and they can be operated separately or together by means of two levels. The twin vertical rudders on the ends of the rear wings can be turned inward across the machine at right angles with its axis, in order to form a brake when the machine makes a sudden descent. The motor used is a 70 horse-power Labor, and the machine is provided with oleo-pneumatic shock absorbers so arranged that the moment the wheels strike the ground a skid is thrown downward in contact with the soil, acting as a brake.

In the pages of the current SCIENTIFIC AMERICAN SUPPLEMENT will be found a discussion of the design from the aerodynamic standpoint.

New Types for the Japanese Navy

By Oscar Parkes

THE sister ships, "Kawachi," which was commissioned last year, and "Setsu," due for completion this year, are Japan's first all-big-gun ships to be built. Their predecessors, the "Aki" and "Satsuma," although often classed as dreadnoughts, were "intermediates" like the French "Danton" and the British "Lord Nelson" types, as they carried a main armament of four 12-inch and twelve 10-inch guns. The "Kawachi" is the normal development of these ships, and in general design seems an enlarged "Katori" with 12-inch guns replacing the 10-inch ones at the four corners of the superstructures, her twelve big guns being distributed after the earlier German fashion, now discarded in that and other navies in favor of the center-line arrangement. The "Kawachi" displaces some 20,750 tons, her dimensions being: Length over all, 481 feet; beam, 86 feet; and maximum draught, 28¼ feet. As originally designed she was to have carried fourteen 12-inch guns, with triple turret fore-and-aft and four twin positions amidships, but this was modified in the earlier stages of construction to twelve guns, twin turrets replacing the triple.

Her secondary battery of ten 6-inch pieces is disposed along the main deck, the end guns being recessed to secure axial fire. The 4.7 guns are mounted at the extreme bow and stern and in the superstructures. Five submerged torpedo tubes are carried, two bearing on each broadside, and one astern. These fire the 18-inch Whitehead weapon.

Her protection consists of the usual complete Japanese belt 12-inch amidships, tapering to 5-inch at the bow and stern, which reaches to the lower deck. Above this is a 9-inch strake amidships, reaching to the battery deck, and here the guns are behind 6-inch armor. A 3-inch armor deck incloses the engines and vitals. All the big-gun turrets are 9 inches thick and are reported to have 12-inch bases.

Both ships are turbine driven, the "Kawachi" having Curtis engines and the "Setsu" Parsons. Steam is generated in Miyabara boilers of standard Japanese pattern, and the designed horse-power of 25,500 is expected to produce a speed of over 20 knots. The coal supply is 900 tons normal and 2,500 maximum.

From our illustrations it will be seen that the ships present a somewhat unique appearance owing to the peculiar funnel spacing, and the two tripod masts of British pattern. The "Kawachi" was laid down at Kure in January, 1909, and the "Setsu" at Yokosuka in April, of the same year, but owing to financial reasons the last-named will not be completed until some time in 1913.

The battle-cruiser "Kongo" is one of a class of four ships of 27,500 tons displacement, and is under construction at the Vickers yard, England. Her dimensions are: Length, 704 feet; beam, 92 feet; and draught, 27½ feet; and she carries an armament of eight 14-inch and sixteen 6-inch guns.

The big guns weigh 80 tons and are 45 calibers long. They are mounted four forward and four aft, the second and third turrets being raised "Michigan" fashion to allow an axial fire of four, and a broadside of eight guns. Along the upper deck are the 6-inch guns, and on the turret tops and upper works are distributed sixteen smaller quick-fire pieces.

Official details of the armor and protection are lacking, but reliable information gives the belt as 10-inch amidships, tapering fore and aft and terminating some distance short of the extremities.

Beneath this is an auxiliary belt which is very deep, protecting the ship against under-water attack. Above is a 7-inch strake extending from the first to the fourth turret bases, and the battery is behind 6-inch armor. The protective deck is 2 inches thick.

Her 14-inch guns are in 9¾-inch turrets with armored bases of unknown, but probably similar, thickness. Driven by Parsons turbines of 60,000 nominal horse-power the "Kongo" has a designed speed of 25 knots, but 27 knots is expected of her. She carries 4,000 tons of coal and 1,000 tons of oil fuel.

Of the four ships, the "Kongo" was laid down in January, 1911, and is to be completed early in 1913. The "Haruna" (Curtis turbines), "Kirishima" and "Hiyei" are all building in Japan, and are due for completion between 1914 and 1916.

Dussaud's "Cold Light"

REPORTS of the experiments that M. Dussaud, a French savant, has been carrying on since 1909 at his "Cold Light Laboratory," have occasionally filtered into the newspaper columns. These reports, although as a rule exaggerated and perverted, have created considerable curiosity about Dussaud and his work. While the discoveries he has made will not "revolutionize electric lighting," as one recent press story predicted, the truth remains that he has applied some old principles to newly and ingeniously devised lighting apparatus, and has conceived some really startling applications for the latter. On three occasions communications by Dussaud have been presented to that august body, the French Academy of Sciences, by Prof. Branly of wireless telegraph fame.

Dussaud's apparatus, in its most typical form, consists essentially of the following parts.

1. A disk or wheel, with suitable mechanism for revolving it.

2. A number of tungsten filament lamps (usually 16 of them) spaced uniformly around the rim of the wheel. The lamps have small, closely coiled filaments, the whole filament structure in a single lamp occupying only 10 cubic millimeters, whereas the filament of an ordinary tungsten lamp encompasses a space some 2,000 times as great. The bulbs are small and round, similar to those commonly used in automobile headlights. A battery or low-voltage dynamo or transformer supplies the current.

3. A commutator, keyed to the shaft of the wheel, which causes each lamp successively to be lighted, for about 1/20 of a second only, as it passes a certain fixed point near the periphery of the wheel.

4. A projecting lens so designed and placed as to receive the light-rays from the lamps, as each in turn passes by the fixed point where it is lighted.

For most purposes (moving-picture machine work for example) the wheel is revolved at a speed of 16 or more revolutions per second, so that the optical effect, due to persistence of vision, is that of a single steady, continuous light emanating from a point. For other purposes, as for example, in light-house beacons, the wheel is revolved more slowly, so that the light is seen to be a succession of flashes.

M. Dussaud finds it possible, by making the apparatus of little inertia and using special mechanism, to stop the wheel during the twentieth-of-a-second or so that each lamp is alight, so that the filament, while lighted, remains stationary at the exact focus of the lens. In the case of lamps with fairly large bulbs, when necessary, he mounts the filament off center, thus bringing it near enough to the inclosing glass of the bulb for the little incandescent coil to be in focus.

There may seem to be nothing startling in all this, but now comes the spectacular part of the performance. Using the apparatus above described. Dussaud finds that *more than twice* their normal voltage can be impressed on the lamps, yet they will last for several hours, while the light is obtained at an economy of electrical energy absolutely unknown with any other illuminating device using incandescent lamps. Thus, by doubling the impressed voltage, a lamp normally requiring 1 watt per candle-power is made to deliver light at an efficiency of 0.2 W. P. C.! He actually impresses 2½ times the normal voltage in certain applications of the apparatus, such as medical examinations of interior parts of the body, and thereby raises the efficiency to 0.1 watt per candle, making a light twice as efficient as that of the yellow flaming arc.

While the efficiency is increased by "overvolting," the candle-power obtainable from a given bulb is increased in still greater proportion. Thus a 200 per cent of normal voltage, a ten candle-power lamp, with a bulb less than two inches in diameter, emits a light of over 140 candles.

There are two advantages in Dussaud's scheme of using several lamps in rapid rotation, rather than a single lamp continuously. In the first place, the life of each filament is increased about twenty-fold, since it is in commission only one twentieth of the time. Secondly, the bulbs do not have a chance to get hot, a fact of great importance when they are used close up to moving-picture films or expensive lenses. Thus the light is a "cold light" in a double sense; very little heat is evolved in proportion to the light delivered, and even that little is so thoroughly dissipated that the apparatus remains cool.

The light intensity in a given direction may, of course, be increased by the use of a reflector in addition to the concentrating lens. Dussaud has two forms of apparatus employing reflectors; in one form the reflectors are rigidly attached to the lamps on the wheel, and revolve with it; in the other form there is a single fixed reflector mounted coaxially with the concentrating lens.

The distinguishing principle of Dussaud's "cold light" may best be stated in his own words:

"This method dissipates the objectionable *heating effect* of the electric current over a *maximum surface* where it offers no inconvenience, and concentrates the useful *luminous effect* on the minimum surface where it is needed."

With a consumption of only 160 watts of electrical energy—which will not produce even the smallest commercial arc light—Dussaud's apparatus produces results in projection work that would be impracticable with even the largest arcs manufactured.

The *applications* that Dussaud has discovered for his invention have done more to bring it into public notice than has the mere fact that the light is surpassingly efficient and intense. And the man is no dreamer. Already he has induced the French Minister of Instruction to give the "cold light" a thorough try-out in the public schools in connection with educational moving pictures exhibitions, while the Minister of War is considering its applicability to military search-lights.

Owing to the comparatively high expense of bulb renewals with the Dussaud system, as well as the necessity of moving parts, one is inclined to view with incredulity any claims that it will ever find much favor as a general illuminant, although the inventor rather naively suggests that it may be used with hollow inverted reflectors to produce beautiful indirect-lighting effects in drawing-rooms, conservatories, etc. Its province seems rather to embrace several specialized applications of electric lighting, to the development of which he is wisely confining his attention.

Among these special applications is that of endoscopy, or examinations of the internal organs of the body. So intense is the light that, when it is placed under the hand, the finger-bones and principal blood-vessels are clearly seen. In many cases it is believed that this powerful, cold light will enable bullets and other foreign substances to be located without the necessity of an X-ray examination. Letters can be read, it is said, even when wrapped in a dozen thicknesses of note paper and inclosed in an envelope.

A second application, already mentioned, is that of cinematography. Dussaud claims that his apparatus will do away with the cumbrous moving-picture machines and asbestos-lined cabinets now in use. No shutter will be necessary to cover the lens during the interval of 1/64 of a second between two successive pictures, for that can be taken care of by the commutator, which causes the incandescent lamp to be extinguished during that interval. Moreover, the present commercial dimensions of the positives, 8½ × 10 centimeters, can be reduced to 19 × 24 millimeters, owing to the possibility of using lenses of shorter focus; in fact, the "pocket moving-picture machine" is seen as an imminent possibility. The cost of the lamp bulbs with the Dussaud machine is about equal to the cost of current with an arc, but a considerable saving is said to result on account of the smaller investment with the former.

Paradoxically, the Dussaud "cold light" is produced at an unusually high filament temperature; indeed it is that very fact that makes the "cold light" possible. As high-temperature radiation is rich in the shorter wave lengths (blue, green, violet, ultra-violet) which are chemically the most active, it follows that the new light is a good one for photographic purposes, such as the making of silver prints. For flash-light photography it can be used on many occasions when magnesium powder would be considered a nuisance.

M. Dussaud is experimenting with a "cold light" machine in which the lamps and optical system are of quartz instead of glass, in order that the chemical and pathological effects of the ultra-violet rays may be studied.

Recent reports indicate that Dussaud's "concentrated cold light" has another field of practical usefulness in light-house beacons.

Shall We Build Battle Cruisers?

Every Big-gun Cruiser Would Mean One Less Battleship in the Fighting Line

By R. D. Gatewood, Naval Constructor United States Navy

1. There can be no doubt that there are many adherents of the new and very interesting type of ships that has recently come into being, variously termed "battle-cruisers," "cruiser-battleships," and "high-speed-battleships," and that there is considerable criticism of our Navy Department, both in this country and abroad, for not building them. It would be difficult to say whether this be due to the fact that other powers have them and we have not; or that the type with its greater size and speed, and its powerful guns, appeals to the popular mind; or that we really do need them.

2. Involving as it would a change of policy and a very large expenditure of money, let us consider the matter from every viewpoint before answering the question that forms the title of this article.

Type.

3. These vessels first came into being in 1906 with the British "Indomitable" class. To-day both England and Germany have battle-cruisers in considerable numbers, and are building more. Japan is building four. We, however, have none; nor are any yet projected.

4. Battle-cruisers differ from contemporary battleships in three main factors:

(1) Greatly superior speed.
(2) Slightly inferior battery.
(3) Greatly less protection.

An examination of Tables I and II taken from Jane will make this quite clear. It will be noticed that while the standard battleship speed stands at about twenty-one (21) knots, the battle-cruiser speeds are from thirty (30) to forty (40) per cent higher. The size of guns in both types is the same, but the cruisers carry fewer of them. The armor belt, which is nine inches on the latest British and German ships, is not only much less in thickness, but is spread over a less area and is tapered more at the ends than is the case with battleships.

5. Future battle-cruisers will almost certainly maintain these differences, and any that we design will in all probability be built to have a radius of action greater than those of other countries, since our strategic position is such as to require this. If we adopt this type, we may therefore expect to have even bigger and more costly ships than any other nation. Assuming that we decide to build such vessels with a speed of thirty (30) knots, an armor belt of eleven (11) inch thickness, eight (8) 14-inch guns, and a radius of action of eight thousand (8,000) miles, a fair estimate of the cost of a single vessel would be twenty million dollars ($20,000,000), and this, of course, does not include the large incidental expenditure involved in deepening channels and enlarging docks which would be necessary.

6. To be of any real use, either tactically or strategically, at least four of such ships, or one division, should be authorized, and not a single unit. Just here it is interesting to reflect that any vessel appropriated for in 1913 could not join the fleet before 1916. At that time, assuming that we build two capital ships per year from now on, the situation will be:

	Japan.	Germany.	United States.
Battleships	6	17	11
Battle-cruisers	7	8	0
Battleships, Second class	13	12	24

Thus, even if two battle-cruisers should be added to our fleet by 1916, they would be opposed to eight similar cruisers of Germany, or seven of Japan, and it is difficult to see how so small a number could accomplish anything.

Uses.

7. In considering now the uses to which this type may be put we naturally consider them under the three heads: (1) Before action. (2) In action. (3) After action.

(*a*) *Before Action.*—There is no question that they would be very valuable for quickly reaching a sea outlet, or occupying an advanced position of importance, or relieving a threatened base, or re-enforcing another fleet in a given time, all of them rôles requiring high speed as well as offensive power.

They would be useful as scouts; but here several things are likely to be overlooked. In the first place, the maximum speed of one of these cruisers cannot long be maintained on account of the excessive coal consumption. At full speed, they will probably burn the equivalent of one thousand (1,000) tons of coal per day. Also it is very questionable whether any commander-in-chief would care to detach far from his battleships vessels that could deliver such powerful blows in the fighting line. Then, too, for anything but distant scouting the aeroplane is undoubtedly going to be superior to any ship. The strong claim made for battle-cruisers for this short-range scouting is that, when used in a screen, they can drive in the scouts of the enemy and prevent them from getting valuable information, and they may even be able to force an action where the enemy is unwilling to engage.

(*b*) *In Action.*—When the action is actually joined they would be very useful in obtaining a position at the head of the enemy's column, opposing his weak end-on fire with their powerful broadside fire and thus "capping" his column, as it is called, and forcing him to change his course. Or they might be used in the much-talked-of, but never-used, formation of the "fast-wing," which is simply a detached body available for threatening the head or rear of the enemy's column, or a weak point in his line.

(*c*) *After Action.*—Assuming that these cruisers have preserved their speed after the battle, which on account of their light armor could probably only be done by keeping them out of it, there could be no doubt that they would be of great value in the pursuit of a damaged and retreating enemy either in heading him off, harassing his flanks, or in reinforcing pursuing destroyers.

8. The above is an outline of the probable uses that would be made of this type by the powers possessing them. Should we attempt any of them, however, it will be at once seen that against any probable enemy we will be hopelessly outnumbered. Also, in all the great naval battles, at Aboukir, Trafalgar, Lissa, Yalu, Manila, Santiago, and Tsushima, there has always been a very decided attempt to force the issue of the action in the shortest possible time, by massing the attack of all possible units; and I believe that, in the last analysis, any such cruisers as we might construct would, of necessity, operate in the line of battleships.[1]

Conclusions.

9. England is building this type because she already has an extremely powerful navy, in conjunction with which they can be used to the best advantage, and also because she needs them to protect her rich and widely separated colonies. Germany is building them because England is, and because she seems able to afford both battle-cruisers and battleships at the same time. Just why Japan is building them at the expense of battleships is indeed difficult to see; but that country has four powerful battle-cruisers of the "Kongo" type, as illustrated on the front page of this issue.

10. For the United States it must be clearly understood that such cruisers could only be constructed at the expense of battleships. We cannot have both, and from the above it is seen that we cannot have the cruisers without a very great expenditure direct and incidental. Under no circumstances should we jeopardize our chances of keeping our battleship fleet up to an adequate standard, and until we can maintain that, the battle-cruiser is a luxury that we can ill afford.

TABLE I.—BRITISH ARMORED CRUISERS.

Name.	Length.	Breadth.	Displacement.	*Speed.	Horsepower.	Main Battery.	Secondary Battery.	Belt Armor.
	Feet.	Feet.	Tons.					Inches.
"Indomitable"	562	78½	17,250	25.0 28.7	41,000	8 12-in.	16 4-in.	7
"Invincible"	562	78½	17,259	25.0 28.6	.....	8 12-in.	16 4-in.	7
"Inflexible"	562	78½	17,250	25.0 28.4	.....	8 12-in.	16 4-in.	7
"Lion"	680	86½	25,000	26.0 31.7	70,000	8 13.5-in.	20 4-in.	9
"Princess Royal"	680	86½	25,000	28.0	70,000	8 13.5-in.	20 4-in.	9
"Queen Mary"	725	87	28,858	28.0	80,000	8 13.5-in.	.. 4-in.	8
"Indefatigable"	580	79½	19,200	25.0 29.1	43,000	8 12-in.	20 4-in.	8

* Upper line designed, lower line on trial.

TABLE II.—GERMAN ARMORED CRUISERS, 1909-1912.

Name.	Length.	Breadth.	Displacement.	*Speed.	Horsepower.	Main Battery.	Secondary Battery.	Belt Armor.
	Feet.	Feet.	Tons.					Inches.
"Von der Tann"	561	87	19,100	27.6 25.0	71,000 80,000	8 11-in.	16 24-pdr. 10 6-in.	7
"Moltke"	590½	88	21,800	28.0 28.4	70,000	10 12-in.	12 6-in. 16 24-pdr.	7½
"H"	590½	88	21,800	28.0	70,000	.....	.....	.....
"J"	590½	88	21,800	28.0	70,000	.....	.....	.....
"K"	.....	.....	23,000	28.0	90,000	10 12-in. or 8 14-in.	12 6-in.	9

* Upper line designed, lower line on trial.

GERMAN BATTLESHIPS, 1908-1912.

Name.	Length.	Breadth.	Displacement.	*Speed.	Horsepower.	Main Battery.	Secondary Battery.	Belt Armor.
	Feet.	Feet.	Tons.					Inches.
"Rheinland" class	472	89	18,500	19.5 20.2- 20.7	20,000	12 11-in.	12 6-in. 16 24-pdr.	9¾
"Helgoland" class	492	92	21,000	20.0 21.1- 21.3	25,000 34,000	12 12.2-in.	14 6-in. 16 24-pdr.	10¾
"Kaiser" class	510	97	23,000	20.0	27,000	10 12.2-in.	14 6-in. 16 24-pdr.	14¼

The Technical Experiment Station of Vienna

WE have received the following communication from the Technical Station of Vienna:

"This station plans to prepare a director of all technical experiment stations at home and abroad.

"For our records we require the following data:

"Statement of the special field covered by the experiment station, address, name of owner, director and employees, date of erection; furthermore, statement as to whether the institute is independent, or is connected with an institution for technical instruction, or with a factory, company or other industrial enterprise; whether the institute is open to the general public, or has been installed only for private practice; lastly, details regarding the installation and size of the institute.

"All technical testing stations, excepting those who have already communicated with the undersigned, are, therefore, requested kindly to make early response to this inquiry.

"The Imperial Testing Office is also prepared to receive information regarding new developments and departures in the field of technical testing.

"The Imperial and Royal Testing Office,
January, 1913. "Exner, *President.*"

Using Ice to Save Apple Trees

A MARYLAND orchardist has found that the balmy spring-like weather prevalent this winter in some sections of Maryland promises to cause a premature blossoming and budding of his apple trees, and is said to have purchased a hundred tons of ice and cracked or broken the same into small pieces which he has packed about the roots of the trees to produce in this manner a temperature which will retard the blossoming of the trees. It is a common expedient to heat orchards to prevent injury by frost, but this is believed to be the first instance where artificial cooling has been resorted to. The orchardist declares that if the warm weather continues, the apple and peach crop in his section will be considerably reduced if not entirely destroyed unless some means are resorted to to prevent the premature blossoming.

[1] In this connection it is interesting to note that the official name recently given to these cruisers in Germany is Linienschiff Kreuzer, or cruisers of the line.

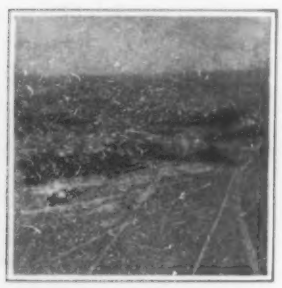
Photographing from a Skyrocket

IT takes an active imagination, surely, to see any sympathetic relationship between a skyrocket and a camera—so delicate is the one, so boisterous the other; but the feat was not beyond the powers of Mr. Alfred Maul, who has linked the one to the other in a happy co-partnership, the results of which are shown in the accompanying excellent photograph taken by his device.

The rocket-camera, as it might be called, was designed for military purposes and was demonstrated before the German military authorities with such success that it has been officially accepted. The problem was not an easy one, and the inventor claims to have been trying to yoke up these two very dissimilar things for some twelve years; for it has taken that time to bring the device to its present undoubted perfection.

The accompanying illustrations, for which we are indebted to the *Illustrated London News*, show the construction of the camera-carrying rocket; the method of mounting and firing it; and the way in which it is knocked down and packed on a light handcart for transportation. The apparatus is described as consisting of a camera held in a pointed hood, at the top of which is a pneumatic electric contact, and a holder which contains a parachute and the upper part of the rocket. On the top of the holder is a gyroscope which serves to maintain the camera in the desired position for the snapshot. The stick of the rocket is about fifteen feet in length, and it is fitted at its lower end with wooden feathers. The whole rocket is twenty feet in length and it weighs about eighty-four pounds. The camera is capable of taking eight by ten-inch plates.

For giving the proper direction in firing, the rocket is mounted in a special form of "gun-carriage," which is mounted at the apex of a stout triangular base, and is capable of being elevated through any range from the horizontal to ninety degrees. When the rocket is fired electrically (from a distance of about 200 yards) the gyroscope is started, and, in about eight seconds' time, the rocket, with the camera, reaches a height of about 2,600 feet. When the rocket is turning at the highest point of its trajectory, the camera being held in the proper direction, covering the field of view, by the gyroscope, the camera shutter is released and the photograph is taken. At the same moment a parachute, which forms part of the apparatus in the head of the rocket, is set free, and the rocket divides into two parts. The parachute opens and the whole of the mechanism, rocket head, etc., drops gently to the ground, landing in about fifteen minutes. We reproduce some of the photographs which have been taken with this instrument, and they are so sharp and clear in definition, that they could not fail to give valuable information regarding the strength and disposition of the enemy's troops, artillery and earth works.



Königsbrück, photographed from a rocket.

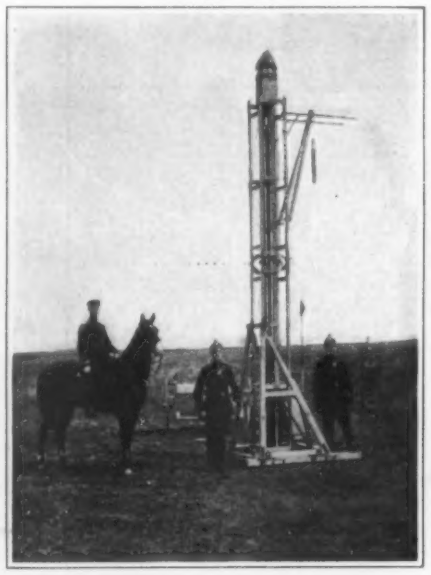
The military rocket-camera knocked down for transportation.

The rocket head, the stick with wooden feathers and the frame.

Rocket photograph of Steuz village under snow.

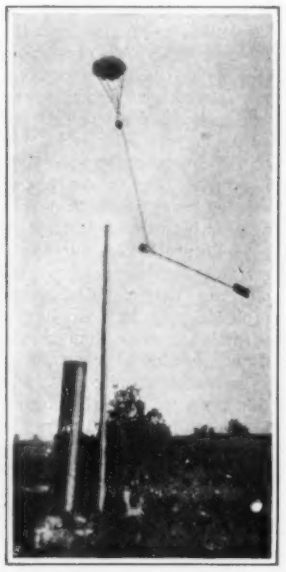
By Courtesy of the *Illustrated London News*.

Laussnitz village photographed from a rocket.



The camera-carrying rocket in its frame ready for firing.

A snapshot of the rocket at the moment of firing.



The parachute bringing apparatus to earth.

ROCKET PHOTOGRAPHY

The Enlargement of the Aswan Dam

By the English Correspondent of the Scientific American

THAT great engineering work, second only in magnitude to the original construction, the enlargement of the Aswan barrage across the Nile, has been completed. The work has been in progress for nearly six years, and although of a somewhat delicate character, it has been carried through to completion without a single untoward incident.

When this barrage was first contemplated Sir William Willcocks, the eminent irrigating engineer, recommended that the great wall across the river, 1.21 miles in length, should be of sufficient height to impound the water to a level of 114 meters (380) feet above sea level, the maximum head of water thus obtained being 26 meters (86 feet), whereby the volume of water stored would amount to 88,300,000,000 cubic feet in round numbers. This seems an enormous volume, but it was only a little more than fifty per cent of that actually required to meet the needs of the country which could be served.

Unfortunately, public opinion demanded the reduction in the height of the barrage, and the Egyptian government responded to the popular outcry. However, the amended work was designed in such a manner that, if the exigencies arose, the wall might be heightened by 6 meters (20 feet) with perfect safety.

After the barrage was opened and the widespread benefits that were bestowed by the scheme became recognized, the mistake in reducing the height of the structure was appreciated. The question as to whether a greater volume of water might not be impounded by raising the crest of the barrage was discussed. Sir Benjamin Baker stated that such an end could be achieved with complete safety, if carried out upon the lines he laid down. He prepared the plans for the alterations, which involved increasing the height of the barrage by 5 meters (16.6 feet) and augmenting its thickness also by 5 meters. In this way the water level would be raised by 7 meters (23.4 feet), whereby the volume of stored water would be increased from 35,300,000,000 to about 81,200,000,000 cubic feet.

The contract, which was estimated at $7,500,000, was handed over to the well-known British contractors, Sir John Aird & Company, who had been responsible for the original works, and to whom we are indebted for the permission to describe and illustrate the alterations. The important problem was the bonding of the new with the old work. Sir Benjamin Baker recommended that, in building up the new part of the masonry, a space ranging from 2 to 6 inches should be left until sufficient time had passed to enable the temperature of the old and new masses to become equal, when they were to be connected by cement grouting.

Accordingly, the new work was built up in front of the old, and was not connected to the latter except by a number of steel rods of 1¼ inch diameter and 8 feet in length, sunk to a depth of 4 feet into the old work, and disposed at intervals of about 3 feet 6 inches. Extreme care had to be exercised to keep out moisture, and also to prevent débris from falling and collecting in the space between the two sections.

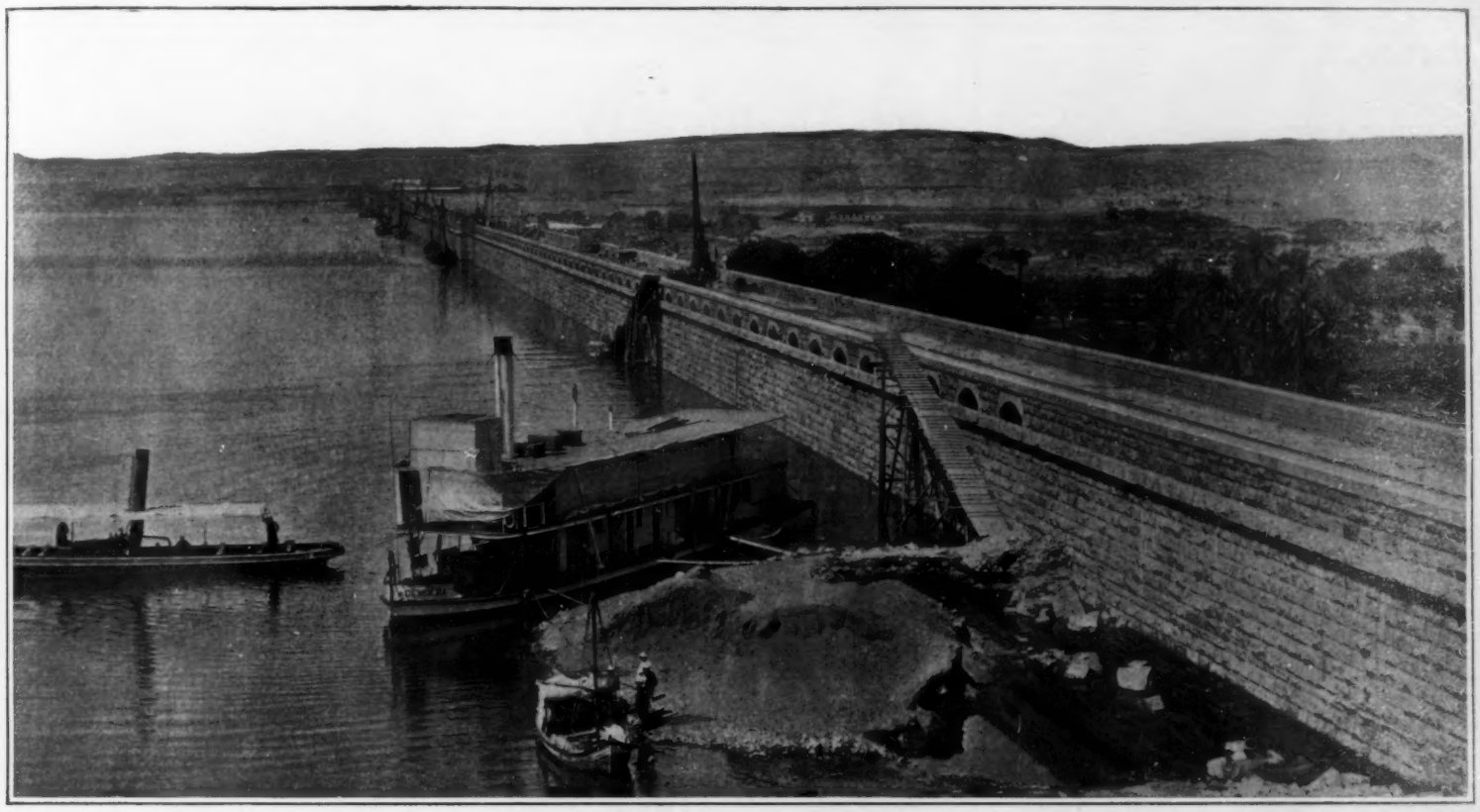
The work of attaching the new masonry to the sloping face of the dam had to be carried out during the periods when the sluices were shut, temporary embankments being improvised with bags of sand to keep the working area dry. The work was done in separate sections, and as it was spread over five seasons, adequate time was offered before the new and old parts of the work were connected by the grouting. Owing to the careful arrangements made by the contractors in regard to labor, the programme, carefully prepared before the work was started, was carried out exactly as planned, and the new parts of the wall stood fully two years before the connecting bonding was taken in hand.

On the western side the barrage terminates in the structure forming the navigation lock. Formerly there were four lifts to meet requirements when the water was impounded; but in the new work a fifth lift had to be added. So far as the locks are concerned the walls of each have had to be raised, the extent of this increase varying from 16.4 feet in the case of the upper lock to 19.7 feet in the case of the fourth lock.

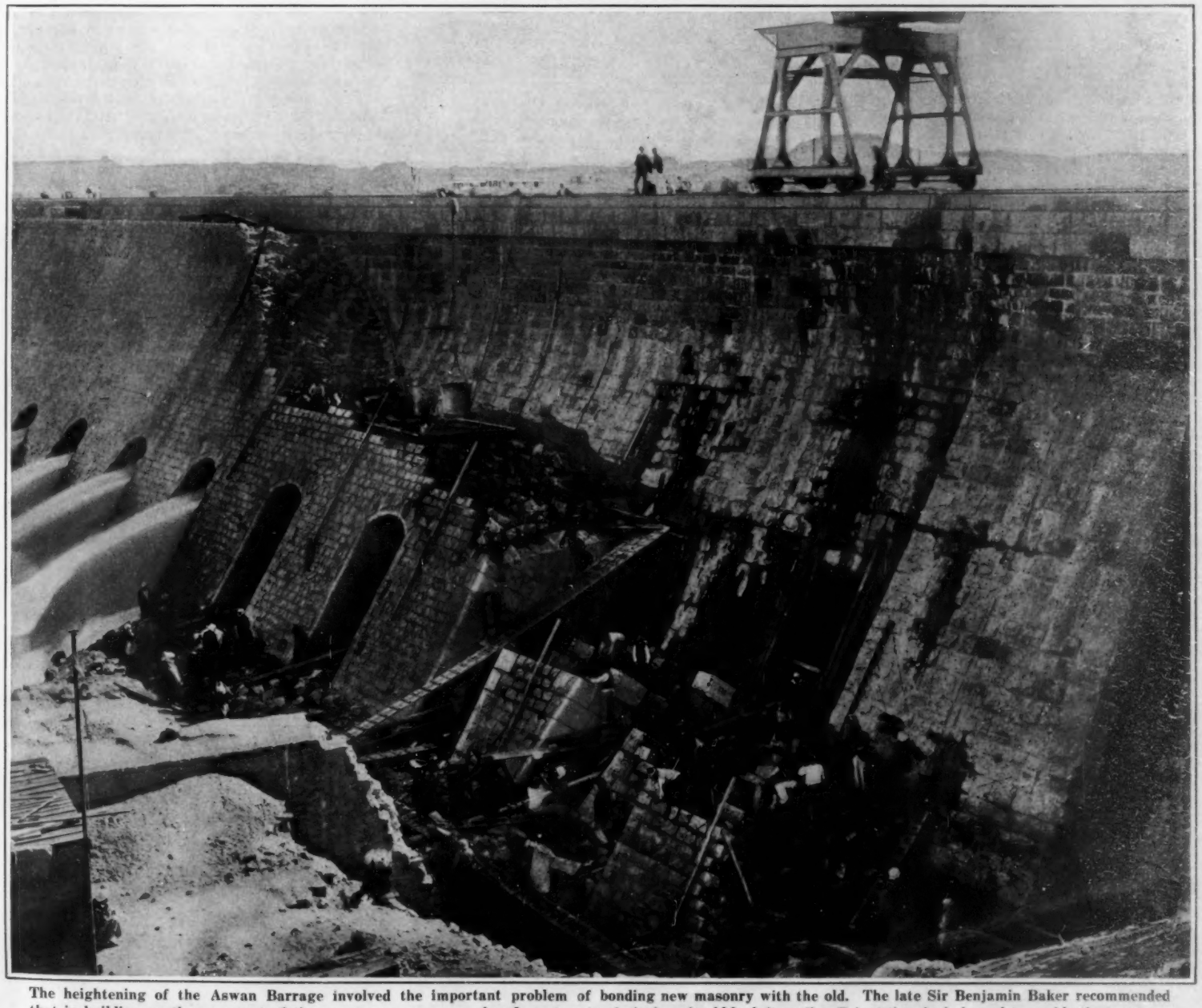
The alterations demanded extensive rearrangements in connection with the lock gates. These, as was pointed out in the SCIENTIFIC AMERICAN upon the opening of the original dam several years ago, are of a special single-leaf sliding type. Now, as the water level has been raised, the depth of water in the uppermost locks is very great, demanding gates 78¾ feet high, by 32 feet 2 inches wide, while the other gates are 59, 52½, 46 and 36 feet in height, respectively. Each is carried on a carriage which rolls over a roller path carried partly on a bascule and partly on the wall of the lock. On the land side a recess is provided in the wall in which the gate is carried when boats are passing through the lock.

In the alterations the gates were either moved bodily

(Concluded on page 147.)



When the Aswan Barrage was first projected Sir William Willcocks recommended that its height should be great enough to impound the water to a height of 380 feet above the sea level. The enormous volume of 88,300,000,000 cubic feet which should have thus been stored up seemed so vastly in excess of the actual requirements that, in response to public opinion, a lower height was adopted. The reduction proved a mistake, and now it has been decided to heighten the structure. Fortunately the necessity of this heightening was foreseen so that it can be easily carried out.

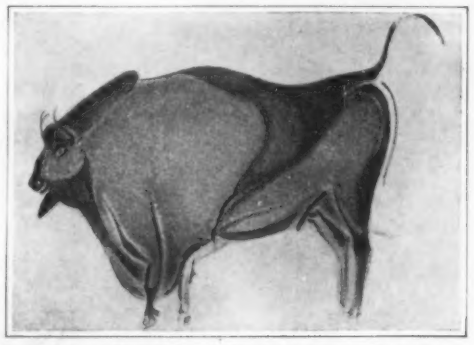


The heightening of the Aswan Barrage involved the important problem of bonding new masonry with the old. The late Sir Benjamin Baker recommended that in building up the new part of the masonry a space ranging from two to six inches should be left until sufficient time had elapsed to enable the temperature of the old and new masses to become equal, whereupon they were to be connected by cement grouting. Sir Benjamin's plan has been followed.

Horse, 1.60 meters from nose to root of tail. Outlines of a hind showing through more recent picture.

The Altamira Wall Paintings

Some Remarkable Specimens of Primitive Man's Art



Aurochs, or European bison, 1.50 meters from nose to root of tail.

THE originals of the eight animal drawings reproduced on this page are probably of greater interest, as documents of human history, than anything that can be found in Egyptian tombs or pyramids. They are, in fact, taken with the circumstantial evidence attaching to them, our warrant for believing that artistic power was highly developed in Palaeolithic man. Of the vigor and correctness of the drawings, there can be no question for anyone who has what may be called the zoological eye. In an article on "Man of the Old Stone Age," in *The American Museum Journal*, Prof. Henry F. Osborn says of these paintings: "The frescoed ceiling of Altamira . . . is the finest expression of palaeolithic art. Not even the faultless reproduction of Abbé Breuil can convey any idea of the impression produced by this wonderful chamber. It ranks for palaeolithic times with the great gallery of Velásquez in the Prado of Madrid. . . ." The date of these paintings has now been determined—roughly, at least—as between two hundred and three hundred centuries ago, in days when European man lived in caves and ate the flesh of the aurochs, or European bison.

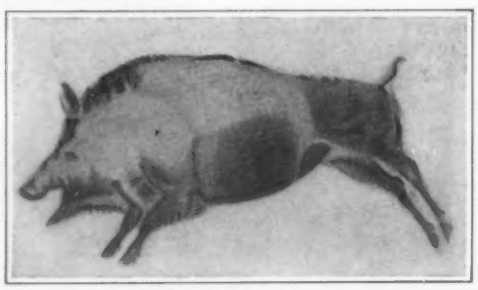
Between that remote period and the day—about thirty years ago—when Don Marcelino Sautuola first had his attention called, by his little daughter, to the figure of an aurochs on the wall of the Altamira cavern, these works of art had probably been seen by no human eye. They are only dimly visible by the scanty daylight which falls upon them. Don Marcelino was busy digging for flint implements in the floor of the cavern and unearthing bones which might tell him what the prehistoric tenants of the cave were in the habit of eating, when his little daughter, pointing at the wall, suddenly exclaimed, "Toro!" Then, by the light of candles, they began the investigation of these pictures which have since become famous, more particularly through the great monograph ("La Caverne d'Altamira") published by M. Emile Cartailhac and the Abbé Henri Breuil.

But fame did not come to the Altamira cavern immediately after Don Marcelino's discovery. After an examination by M. Harlé, it seemed that the thinness of the crust of lime which coated the pictures indicated a comparatively recent origin, and their true palaeontological significance might have been lost had it not been for other wall paintings found in other caves, which carried with them—in the fact that the subjects included palaeolithic animals, such as mammoths—evidence of extreme antiquity. Altamira is in the neighborhood of Santillana, in the Asturian province of Santander, which lies to the south and west of the Pyrenees. North and east of the same range investigations at several other places brought to light other drawings of animals, notably those of La Mouthe (1895) and Combarelles (1901). The increased interest in prehistoric cave pictures, leading to comparison of all these discoveries, and study of the remains found on the smoke-blackened hearths, ended in the conclusion that Altamira, as well as its French counterparts, was indeed a palaeolithic dwelling.

One of the first difficulties in the way of accounting for these paintings was the absence of daylight upon the surfaces which they adorn. Palaeolithic man, presumably, could not paint in the dark, or even in a twilight, any more than modern man. But modern man—Don Marcelino Sautuola and those who followed him—needed good modern candles to obtain a good view of the pictures, and they had some difficulty in keeping the smoke of their candles from blackening the painted walls, just as the smoke of palaeolithic kitchen fires had left its mark to endure for more than twenty thousand years. It was only after a study of the remains of utensils found in the caverns that the *savants* solved this difficulty by the hypothesis that the prehistoric artists used lamps consuming animal oils, somewhat analogous to the blubber lamps of the Eskimo. Such lamps would give a very clear light, with hardly any smoke. There remains the question: Why should the primitive artists have chosen to decorate the darker recesses of their dwellings, rather than practise their art where the light of the sun would have helped them?

Bellowing aurochs painted over unfinished sketch of one charging.

Boar, 1.45 meters long from snout to tail. The artist began his sketch with one pose and finished with another.



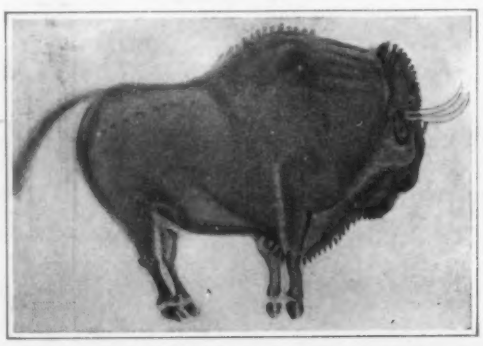
Galloping boar, 1.60 meters from root of tail to snout.

The answer to this question is connected with certain features in the wall paintings which at first were in themselves much in need of explanation. In the first place, the various figures are not arranged in the form of friezes, or in any other way which would indicate that their intention was decorative: they are placed here and there without any apparent artistic design whatever, though some of them are so drawn as to utilize accidental unevennesses of surface, giving something like an effect of colored reliefs. Then again, the figures are sometimes surrounded by lines of conventional indications which have been interpreted as representing little primitive houses. Putting all these circumstances together, it seems probable that the paintings were made not for the love of beauty, or to "show the hand" of palaeolithic Giottos, but with strictly business aims. They were, in fact, primitive pot-boilers, done to supply the larder with material. In none of the caves is there a picture of any animal that was not eatable, and—by the evidence of the bones found on the hearth—actually eaten by the cave-dwellers. The same, it appears, is true of the animal pictures made by Australian aborigines. The hypothesis of M. Salamon Reinach is that, like the Australian aborigine, the palaeolithic man of Southern Gaul and Northern Spain believed in his own paintings of deer, boars, aurochs, horses (considered good eating) and mammoths as potent to attract the animals themselves. The pictures were supposed to operate as charms on the very big game which they represented, so that these creatures found themselves instinctively wandering into the vicinity of the cavern adorned with their effigies, and the farther in the pictures were, the more secure would be the capture of the subjects.

As to the primitive apparatus with which these paintings were achieved, the learned investigators have reached some important conclusions. Whatever may have been the material of the pigments, it was ground in stone mortars with stone pestles. The pigments were laid on with animal fats, instead of oils, from a palette consisting of the scapula of some animal. For brushes, it is supposed that these primitive painters used the feathers of birds or sticks chewed at the ends.

Three animals: an ox (finished), a horse and a boar (sketched). 2.25 meters between the extreme muzzles.

Hind, 2.20 meters long. Evenness of the outlines indicate a smooth wall surface. Small aurochs to the right.

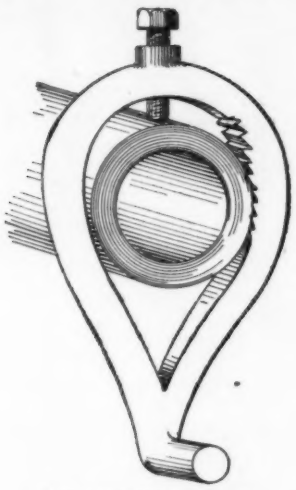


Aurochs, 1.50 meters from forehead to hind quarters. Outline formed partly by irregularities of the surface.

Notched Lathe Dog

By William Grötzinger

AN ordinary lathe dog can easily be prevented from letting its work slip and causing trouble. The following method will prove good: Take a three-cornered file and file several deep notches into its inner face at

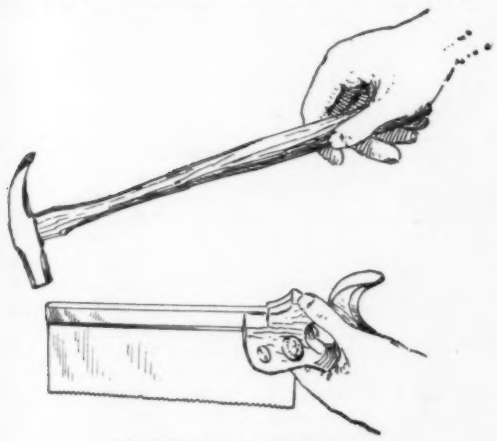


Non-slipping lathe dog.

one side. Now put the work and dog in place as illustrated, and the dog will grip it with astonishing firmness. Work as large as the dog will admit can now be turned without slipping.

Straightening a Back Saw

AFTER the back saw has been set and filed quite a number of times it will become slack and kinky along the saw tooth edge. If the saw is properly con-



Straightening a back saw.

structed, one tap of the hammer on the back at the extreme end, will straighten it instantly.—A. B.

Chair Making One Hundred Years Ago

By Albert F. Bishop

QUITE frequently in occupying a very old chair it will sway from side to side quite easily, but still the parts will not separate. This is due to the construction, which is quite ingenious. The wood in shrinking grips tightly on the rounds. The uprights or legs marked *A* are of green wood. The rounds and curved

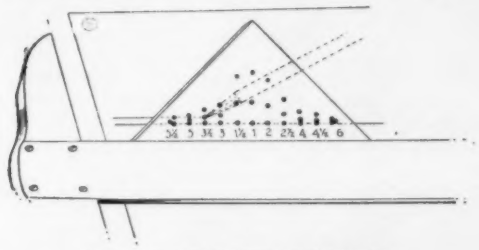
Chair construction of our great-grandfathers.

back connections marked *B* are thoroughly seasoned. You can readily see that when the green wood becomes seasoned it will shrink very tightly on the seasoned pieces, so much so that they very seldom come apart, although there is no glue used.

Lettering Triangle

To the Editor of the WORKSHOP DEPARTMENT:

Referring to the different suggestions for making the guide lines for lettering drawings that have appeared from time to time in your columns, I wish to call attention to a very neat device stationers are selling over here. It consists of a triangle made of celluloid and provided with vertical rows each of three flaring holes. Placing the point of a lead pencil into one of the holes



Drawing guide lines for lettering.

of the row selected, the triangle is run along a ruler by means of the pencil point. Arrived at the end of the line thus drawn the pencil is placed into another hole of the row in question and a line drawn in the opposite direction. The operation is repeated once again and these lines will be found to be drawn exactly parallel and spaced correctly apart. The rows of holes are designated by the number of the round-writing pen best adapted for the size of letters in question.

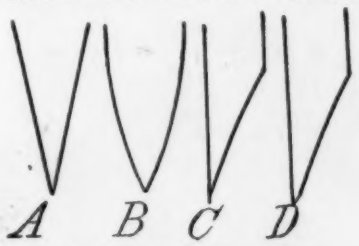
Bonn, Germany. ED. C. MAGNUS.

Sharpening Edge Tools

By W. D. Graves

THE essential feature of a good cutting edge is that its two sides shall form a sharply defined acute angle, which can only be attained by having such sides straight as shown, much magnified, at *A* in the drawing, rather than curved as shown at *B*. Where the novice usually fails in whetting an edge tool is in giving it a rocking motion, producing the rounded edge; and the principal element of skill in the operation lies in holding the blade and the stone at the same relative angle throughout. There are some apparent exceptions to this rule, as the common ax; but they are only apparent, not real. An ax used for chopping is better ground with the sides smoothly curved, but the sides of the extreme edge, if it is a good edge, must be straight. Of course these straight sides may be very short, only as long as they are made by the final "setting," or whetting, of the edge, but they are there.

The proper "thickness" of the edge, i. e., the degree of acuteness of the angle formed by the two sides, depends wholly upon the nature of the tool and the work it is intended to perform. A "thin" edge will, of course, cut more easily, but it will also break and become dulled more quickly; so the proper angle must be determined, by observation and experiment, for each tool and purpose. The conservative beginner will aim to err in the way of making the edge too thick; then as he finds it amply strong to do the work without breaking or nicking he will make it a little thinner, and so proceed till he learns the most effective and



Various forms of cutting edges.

economical angle. An edge which would be sufficiently enduring on soft pine would become almost immediately blunted on lignum vitæ; while, for use on any given wood, differently tempered tools require sharpening at different angles in order to give the best results.

As most wood-cutting tools are sharpened like a chisel this form of edge may perhaps best be used in illustrating the method of sharpening all. If the tool is very dull the work of sharpening is expedited by first grinding it on a stone or wheel of a grit too coarse to make the final cutting edge; taking care to have it symmetrical and either straight or of the curve of the grinding wheel, as shown at *C*. This method of making the sides inwardly curved—or "hollow grinding"—which is carried to its extreme in razors, lessens the work of whetting, but tends to make the edge weak and incapable of withstanding hard usage.

On the grindstone or abrasive wheel the tool is brought to an edge somewhat more acute than is desired for the finished one; but, owing to the coarseness of the abrasive used, it is too rough for keen cutting. The final edge is "set" by rubbing with or on a flat finishing stone of finer grit, making a new and sharply defined bevel as shown, magnified, at *D*. All cutting edges are somewhat serrated, some being finished on a stone so coarse that the serrations may be seen with the naked eye, as that of the common scythe. Such edges are made to cut by a sliding action, like a saw; and, for that matter, even a razor will cut much more readily if given a slight endwise motion.

Strap Hinges vs. T-Hinges

By G. W. D.

IN deciding whether to use strap or T-hinges one should keep in mind the fact that, when the two are of the same nominal size—as six-inch or five-inch—and of about the same cost, the T-hinge is about twice as strong as the other. A thing is only as strong

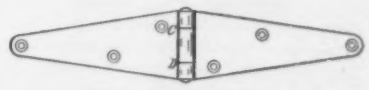


Fig. 1.—Strap hinge.

as its weakest part, and the weakest part of such hinges is the joint, or that part of the flap which bends around the pivot. Both strap and T-hinges usually fail through the straightening out or breaking of this part; and, as will be seen by reference to the accompanying

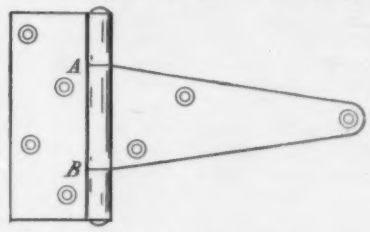


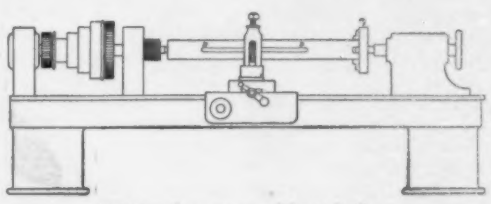
Fig. 2.—T hinge.

sketch, this part is twice as wide in the T form as in the strap. In the T-hinge it is of the whole width of the strap, as at *A B*, while in the strap hinge it can be of only half that width, as *C D*.

Cutting Keyways With a Lathe

By H. D. Chapman

A METHOD of cutting keyways with a lathe is pictured in the accompanying drawing. A plug center is made to screw in the lathe chuck, as shown at *A*. The center is then placed in the tail stock of the lathe. The shaft is then placed on the center and the other

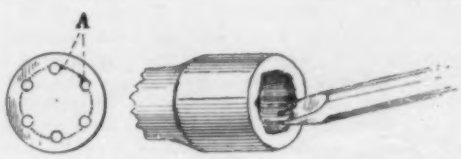


Cutting keyways with a lathe.

end in the chuck, thus holding the shaft rigid while the keyseat is being cut. A hole is drilled at either end of the keyseat *BB*. This gives the tool clearance while it is being machined. The lathe is geared up to a high pitch, the tool is set in the tool post, the lathe is started up, and the feed is then thrown in, thus feeding the carriage along the work. Of course a special tool is required to suit the keyseat. A keyseat can be cut in a lathe just as well as it could be in a shaper.

Making a Socket Wrench

MOST mechanics will not take the trouble to cut out a socket wrench, but this is easy enough when done according to the drawing. It is laid out on the steel for drilling. Six small holes should be drilled if the socket is to be a hexagon. These holes



Method of cutting out a socket wrench.

will cut out the corners. Then one large hole is drilled in the center which will cut out nearly all the stock and should cut two thirds of its way into the small holes. Then there is but little chipping to be done after this operation; simply two small fragments, which are indicated at *A*.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Recent Improvements in Machine Tools—I

[*IT has often been said, and rightly so, that the perfection to which metal working has attained is one of the miracles of modern times. In many factories throughout the country the various pieces are turned, milled, sawed, planed, or ground in such quantities, at such speeds and with such unfailing accuracy as to command the admiration of the observer. Yet in spite of this perfection there always seems to be room for further improvement. This is the first of a series of brief articles on recent improvements that have been made in machine tools.*—EDITOR.]

AMONG the inventors who have recently added valuable changes to the highly developed art of machine tool manufacturers are F. L. Eberhardt and W. F. Zimmerman of Newark, N. J.

The device patented by these inventors is a machine for cutting the teeth of helical gear wheels, without imparting a differential motion either to the blank to be cut or to the cutter.

The advantage of this invention lies in the fact that a single direct connection is established between the rotation of the cutter and blank spindle, an advantage which is an essential feature in all generating mechanisms. A more perfect control of the feeding mechanism, both of the cutter and of the blank itself as well as of the relative ratios of rotation of the cutter and blank, is thus effected.

In the figures, the work table 3, adjustably mounted upon the frame 1, is provided with a revoluble work spindle 4 in which the work arbor 5 is secured, whereby the gear blank 6 is centered and secured to the spindle 4. A worm wheel 7 is fastened to the lower end of the work spindle 4 and rotated by the worm 8 in engagement therewith. This worm is mounted in the bearings 9 of the work slide 3, and is provided with a gear 10, which meshes with a gear 11 slidably keyed to the index shaft 12.

The index shaft 12, mounted in bearings at either end of the frame 1, is connected to the index driving shaft 13 by means of a compound train of change wheels 14, 15, 18, and 19 to drive the feed of the helical cutter 31. The stud 16, carrying the gears 15 and 18, is slidably arranged in the arm 17 to accommodate change gears of different diameters. This arm 17 is pivotally mounted upon the driving shaft 13, and is secured in the various positions by the bolts 22 to the bearing 21.

The drive shaft 13, which imparts motion directly to the gear blank receives its motion from the main shaft 25 (Figs. 2 and 3) rotated by the cone pulley 28 through the worm wheel 26 and the worm 27. The ratio of the worm wheel 26 and worm 27 must be equal to or a factor of the ratio between the main driving shaft 25 and the helical cutter so that for each rotation of the cutter the index drive shaft will make a complete rotation or a multiple thereof.

The helical cutter 31 is secured to the cutter shaft 32, mounted to rotate in the swivel carriage 33. The cutter carriage 34, upon which the swivel carriage 33 is mounted, is vertically adjustable upon the stanchion 2 and is parallel to the axis of the gear blank. The swivel carriage 33 is secured to the cutter carriage 34 in any angular position in relation to the gear blank by bolts 35 in the T-slot 36.

The helical cutter is pivoted about the shaft 42 by means of the bolts 35 and T-slot 36, and a rotatable connection through the driving gear 37, pinion 38, shaft 39, bevel gears 40, 41, 43 and 44 is thus secured with the cutter drive shaft 45 for any angular position of the cutter.

For reversing the direction of rotation of the helical cutter, the bevel gears 47 and 48 on the drive shaft 25 are operated by the yoke 49 and handle 50 to engage, alternately, the bevel gear 46 on the cutter drive shaft 45.

The feed of the cutter parallel to the axis of the gear blank is obtained through the change gears 23 and 24, feed worm shaft 53, feed worm 54 and wheel 55, from the index driving shaft 13, which rotates in synchronism with the helical cutter. The feed screw 56 engages a threaded portion 57 of the cutter carriage 34 and is rotated by the feed worm wheel 55.

To arrange the apparatus to cut helical gear wheels with a helical cutter, the gear blank is mounted upon and secured to the work spindle; the cutter is secured to the cutter spindle, and the swivel carriage is adjusted to the proper angle with relation to the gear and according to the angle of helices to be cut, and is secured in such position by bolts. The change feed gears are selected in accordance with the material of the blank and the angle of the helices and placed in position. The proper index change gears are next placed between the index driving and index shafts. The work blank is then adjusted by the screw 58 and the hand wheel 59 for the proper depth to be cut.

The teeth of the gear will then be cut by one passage of the cutter across the face of the blank.

(*To be continued.*)

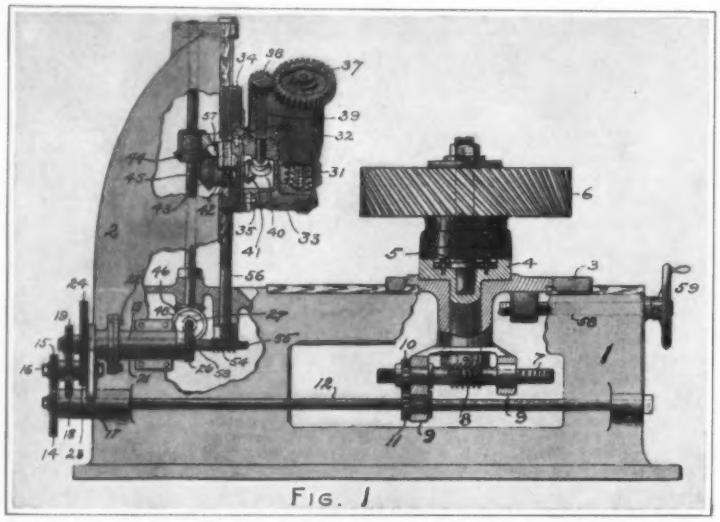


FIG. 1

A single direct connection is established between the rotation of the cutter and blank spindle, an advantage which is an essential feature in all generating mechanisms.

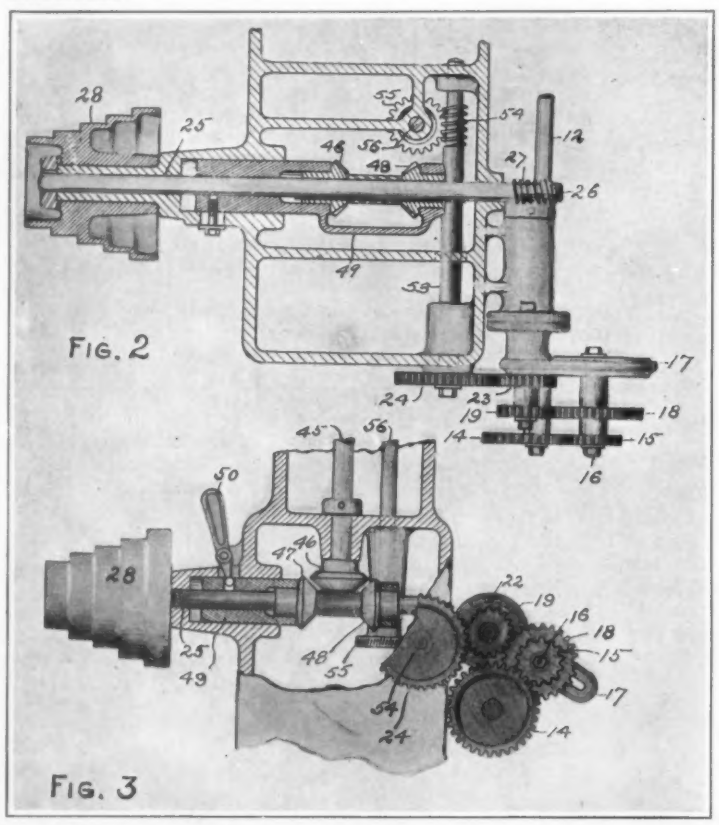


FIG. 2

FIG. 3

A machine for cutting the teeth of helical gear wheels without imparting a differential motion either to the blank to be cut or to the cutter.

Prizes Offered by German Engineering Societies

THE Verein Deutscher Maschinen-Ingenieure offers a number of prizes, as follows:

I. A prize of 1,500 Marks for an investigation of the causes and means of prevention of street noises due to railways and street railways.

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IV. A prize ranging up to 4,000 Marks for the design and computation of springs for railway carriages.

Readers interested in these competitions are advised to address further inquiries regarding details and conditions to: Die Geschäfts stelle des Vereins Deutscher Maschinen-Ingenieure, Lindenstrasse 80, Berlin, S. W.

COMPETITION FOR MINER'S ELECTRIC SAFETY LAMPS.

According to *Electrical Engineering*, a prize of $6,250 for the best electric lamp provided with a reliable fire-damp indicator is being offered for competition in Germany by the Verein für die Bergbaulichen Dortmund. The lamp is to be capable of giving a light of one Hefner candlepower after burning for 12 hours, must be safe in the presence of fire-damp even if damaged. Three lamps with descriptions (in German), drawings, etc., in triplicate, must be submitted to the Verein, at Essen-Ruhr, before October 1st, 1913. The judges will be a committee representing the Government, the Westphalian Miner's Association, and the Dortmund Mine Owners' Association.

Automatic Fog Gun

By E. O. Carter

AN automatic fog gun is now being put to active service on the Clyde. The invention consists of a method of obtaining powerful explosions of a mixture of acetylene and air at regular predetermined intervals. The machine is at present made in two sizes, the cost of working being, respectively, about 4 cents and 6 cents per hour.

The writer when in Glasgow recently had the pleasure of hearing the smaller machine at work, and the noise of the explosions was sufficient to take away any desire to hear the larger machine! A powerful acetylene fog gun has already been erected on a rock station off the west coast of Scotland, where it has proved itself much superior to the sonite signals usually placed in such situations, as it is not liable to be exploded prematurely and is not open to the danger of being fired by lightning. Furthermore, it does not require the constant supervision of a keeper to put on charges and fire them, as it is entirely automatic. Once started it will continue until stopped. Where the apparatus is fixed on an isolated rock, and in other situations where a wire connection is inadvisable, it is intended to arrange that it shall be started and stopped from shore by means of a small wireless installation.

The invention is thus admirally adapted for use on buoys and where expense and want of space on which to build prohibit the use of compressed air fog signals.

The present machine is the outcome of years of experiment covering a variety of gases, the mixture of acetylene and air having been found to give the best results.

The Death of James B. Hammond.—James Bartlett Hammond, inventor of the typewriter that bears his name, died at St. Augustine, Fla., on January 27th. He had a varied career. Originally intended for the ministry, he graduated from the University of Vermont, and eventually entered the Union Theological Seminary. He soon gave up the idea of joining the church, and went to Germany, where he studied philosophy. He was a war correspondent during the Civil War. As a shorthand reporter in a Boston court, he first conceived the idea of his typewriter. To this he devoted the rest of his active career. He made a large fortune out of his invention.

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PATENTS FOR SALE

UNITED STATES PATENT No. 1,001,311 and Canadian Patent 138,712: illuminated street indicator for interior of street cars. Only machine invented for showing streets from interior of cars. Address W. D. Seale, 850 Driggs Ave., Brooklyn, N. Y.

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

DEVICE FOR HOLDING TEETH IN AGRICULTURAL IMPLEMENTS.—M. L. AKERS, Pendleton, Ore. The invention is particularly adapted for holding the teeth of drag harrows against their supporting bars. It provides means for adjusting the teeth quickly, perpendicularly to the frame bar of the harrow or at an angle laterally to the line of draft.

DEVICE FOR EXTERMINATING VERMIN ON HOGS.—A. W. APPLEGATE, Brawley, Cal. In order to exterminate vermin on hogs, Mr. Applegate provides an apparatus which may be set up within an opening in a fence or other inclosure through which the animals pass and thereby actuate an oiling device. Means are provided for preventing waste of the oil, and applying to the backs of the animals only so much as is necessary to exterminate the vermin.

STUMP-PULLER.—J. M. PHILBROOK, Beach, Wash. The invention is directed to an improved construction of stump-puller adapted to be operated by a draft animal, the construction and arrangement being such that the drum on which the rope is wound to pull up the stump is adjustably connected to the sweep arm, so that these arms and the drum are in turning relations with each other only when the sweeps are moving.

DRINKING FOUNTAIN FOR POULTRY.—G. W. GIBBENS, Hadley, Ill. The principal objects of this invention are to provide means for preventing chicks or other poultry from fouling or otherwise disturbing the drinking water, to prevent the budding or crowding of poultry about the fountain, and to provide a simple compact structure that may readily be transported.

Of General Interest.

COUNTER.—J. G. BIGGAR, Linoleumville, S. I., N. Y. Mr. Biggar's counter has a plurality of sections, each having ten parallel ruled lines with holes, in the neighborhood of which are printed the digits and a naught, the sections reading from the right to the left, units, tens, hundreds, etc., so that when a pen is inserted in the 5 hole in the units section, in the 6 hole in the tens section, in the 4 hole in the hundreds section, and in the 8 in the thousands section, the sum indicated will read 8,465.

CARD HOLDER.—J. A. MANSON, 347 W. 87th St., New York, N. Y. The invention relates to a holder for sales cards, which may be readily mounted and which will positively retain the cards in removable position. It consists of a light metal sheet, the outer edges of which are turned inward on both sides of the sheet to hold cards upon opposite sides of the same, the sheets being mounted upon a suitable support.

PROCESS FOR REMOVING COPPER FROM OTHER METALS.—R. R. MORENO, care of Bethlehem Steel Works, Allentown, Pa. Before they are accepted guns must be subjected to proof firing tests with charges of progressively increasing size. In these tests copper bands of the projectiles are scraped by the compression slopes and rifle parts until they become fouled with a coating of copper. This invention provides for dissolving the copper by an ammoniacal solution in the presence of air.

Machines and Mechanical Devices.

SEPARATOR.—C. FREDRICKSON, Lock Box 113, Rice Lake, Wis. The object of this machine is to separate potatoes into various sizes or grades and at the same time to clean them. Means are provided for transporting the potatoes without injury to a separating screen, and dumping or forcing them on the screen while the screen is in operation so that the potatoes will move in a continuous stream.

WASHING MACHINE.—J. W. PIPPIN, Brownwood, Tex. This machine consists of a boiler with a receptacle for clothes therein, the receptacle having a perforated bottom and sidewalls. The boiler is placed in a furnace which heats the water in the boiler, converting it into steam and forcing it into the receptacle through the clothes. A disk valve prevents the steam and water from entering through the perforated bottom. When the steam is cooled and condensed by passing through the clothes the disk valve drops open, permitting the water to return to the lower portion of the boiler.

POWDERED COCOA FLUFFER, MIXER, AND COOLER.—P. G. HOLLSTEIN, care of J. M. Lehman Co., 13 Laight St., New York, N. Y. The machine consists of a number of superimposed pans in each of which are revolving arms, acting in succession on the cocoa to cool, stir up, fluff, mix and knead the cocoa particles after which they are forced through openings in the bottom of one pan to the next, where the same operation is repeated, and so on through the pan series.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Architecture on Panama Canal

(*Concluded from page 136.*)

that it strikes us as an architectural hybrid. The slender supporting pillars, carrying a square, shallow platform, from the center of which rises abruptly the massive bulk of the tower, present a combination which, from an architectural point of view, is, to say the least, extremely inharmonious and unbalanced.

This range tower would be an eyesore at any point along the Canal; but standing, as it does, in a particularly prominent position, where it will immediately catch the eye of everyone who makes the transit of the locks, whether they approach them from the Atlantic or from Gatun Lake, it will serve to belittle the monumental Gatun locks.

The SCIENTIFIC AMERICAN has always urged the necessity for the collaboration of the architect and the engineer in all cases where there is an opportunity to give architectural expression to engineering construction; and we have never seen a case where the call for such collaboration was so strong as here. The Editor of this journal is no architect; but he has ventured to present the accompanying sketch as showing that the engineering requirements of this problem might have been met in a manner more pleasing to the eye and more consistent with the dignity of the Panama Canal structures.

The cost of reconstructing this particular tower, or at least the lower half of it, would be relatively trivial. We commend the question to the attention of the Isthmian Canal Commission.

Voice-operated Typewriter.

(*Concluded from page 136.*)

speech will be faithfully recorded in type. However, there are serious limitations which must be considered. In referring to the work of the human typist, we took an example in which no complicated exercise of mental faculties was required, merely a simple word phonetically spelt. Surely in the making up of sentences, starting a sentence with a capital, punctuating it properly, and spelling the words according to the dictionary, a great deal of reasoning power is necessary. What can the machine do in such a case?

The inventor proposes a special form of electric typewriter in which unlimited speed can be obtained by arranging the type bars in a full circle and placing the paper on a vertical cylinder, revolving at constant speed. Then on account of stops between words, a space equal to the width of one or more letters would be automatically produced between the words. Instead of using capitals and small letters, it would be preferable to use nothing but capitals. However, if it were essential to have both capital and small letters, then at the beginning of a sentence a certain little-used sound might be uttered which would operate the shift key of the typewriter so as to produce a capital. The same means could be adopted for operating the period and comma keys. But the principal drawback of the system is that the writing would be phonetic. How can the machine distinguish between "to" and "too" and "two"? Obviously it cannot compete with the human typist, particularly in the English language, as long as we stick to our abominably complicated spelling, unless the dictator comes to the rescue, by pronouncing the words as they are spelled. This would be quite a task with some words, such as "phthisic" or even so simple a word as "laugh."

However, the inventor makes no undue claims for his machine. It is his idea that it might be used as a dictation machine in place of a phonograph. In this connection it offers many advantages, principally because the dictator is able to see just what he has written, and can make corrections and refer back to statements he has already made without laboriously hunting over a cylinder, as is now necessary with the common dictation machine. The phonetic unpunctuated draft made in this way could then be transcribed by a typist. It is quite possible that if the machine were introduced into

commercial service, it would do much toward the cause of simplified spelling. The man who is accustomed to seeing his letters and other writings typed phonetically would soon learn the advantages of this form of spelling and would be liable to adopt it.

Another possibility of the machine is that it could be connected to a telephone to take down telephone messages automatically and print them on the electrical typewriter. It has also been suggested that the machine could be used to advantage in schools for deaf mutes, as it would afford the pupils a means of determining, visually the character of the sounds they are uttering in learning to speak.

However, the inventor is not oversanguine of the commercial development of his invention. The apparatus must necessarily be very sensitive. The resonant tones of certain letters are so close that a very careful tuning is necessary, and the dictator must learn to talk in a monotone after the machine has been tuned to the fundamental pitch of his voice. Mr. Flowers does not present his invention as a complete solution of the problem of the voice-operated typewriter, but merely as a step toward that end, which may lead to further development on his own part, or on that of other inventors.

Enlargement of the Aswan Dam

(*Concluded from page 104.*)

from their present position to be set in the succeeding step, or where cut down to meet the new situation, while new gates were required for the original No. 1 lock owing to the height of the water being increased.

The thickness of the masonry dam as now completed is increased at the top from 23 to 36 feet, and it carries a roadway 29½ feet instead of 18.4 feet wide. The roadway is provided with a track along which moves an eight-wheeled 100-ton crane of 25 tons capacity.

Doubtless the raising of the flood level behind the barrage will be regarded with misgivings by those interested in Egyptian archæology. It was respect for this agitation which induced the government to reduce the height of the first drawings for the dam. Still, it must not be forgotten that the very existence of the Soudan depends upon the supply of water for the crops, and accordingly antiquarian must give way, to a certain degree, to utilitarian interests. The Egyptian government during the past five years, while the alterations to the barrage were in progress, devoted $500,000 to the preservation of all archæological relics within the flooded area. This work was intrusted to Mr. Weigall, inspector for Upper Egypt of the Department of Antiquities, and he has carried out his work in a thorough manner. While a certain number of the ancient buildings now are lost forever, and others are periodically submerged, all the most important ruins are secured. Their foundations, which were decrepit, have been strengthened, and a certain amount of judicious restoration has been made in the case of the more dilapidated buildings. All the inscriptions below the high-water mark of the impounded water have been carefully copied for preservation, although some of the colored frescoes must unavoidably be damaged by the periodical submergence. True, some of the buildings will be less accessible now than formerly, but the student of Egyptian antiquities need only to select a suitable season for his visit, when he will be able to wander among the ruins with even greater facility than formerly.

The raising of the dam and the water level virtually completes the irrigation scheme which was elaborated by the engineers and advisers to Lord Cromer's government, although a comprehensive improvement and development scheme in the Delta is in progress. Although the project was severely criticized at the time of its inauguration, subsequent events have proved that the irrigation projects represent the greatest benefits that have been bestowed upon Egypt since its occupation by the British, while financially the scheme is proving a complete success.